THE INDEPENDENT GUIDE TO PERSONAL COMPUTING SEPTEMBER 14, 1993 VOLUME 12 NUMBER 15 $2.95

PC MAGAZINE

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PC MAGAZINE

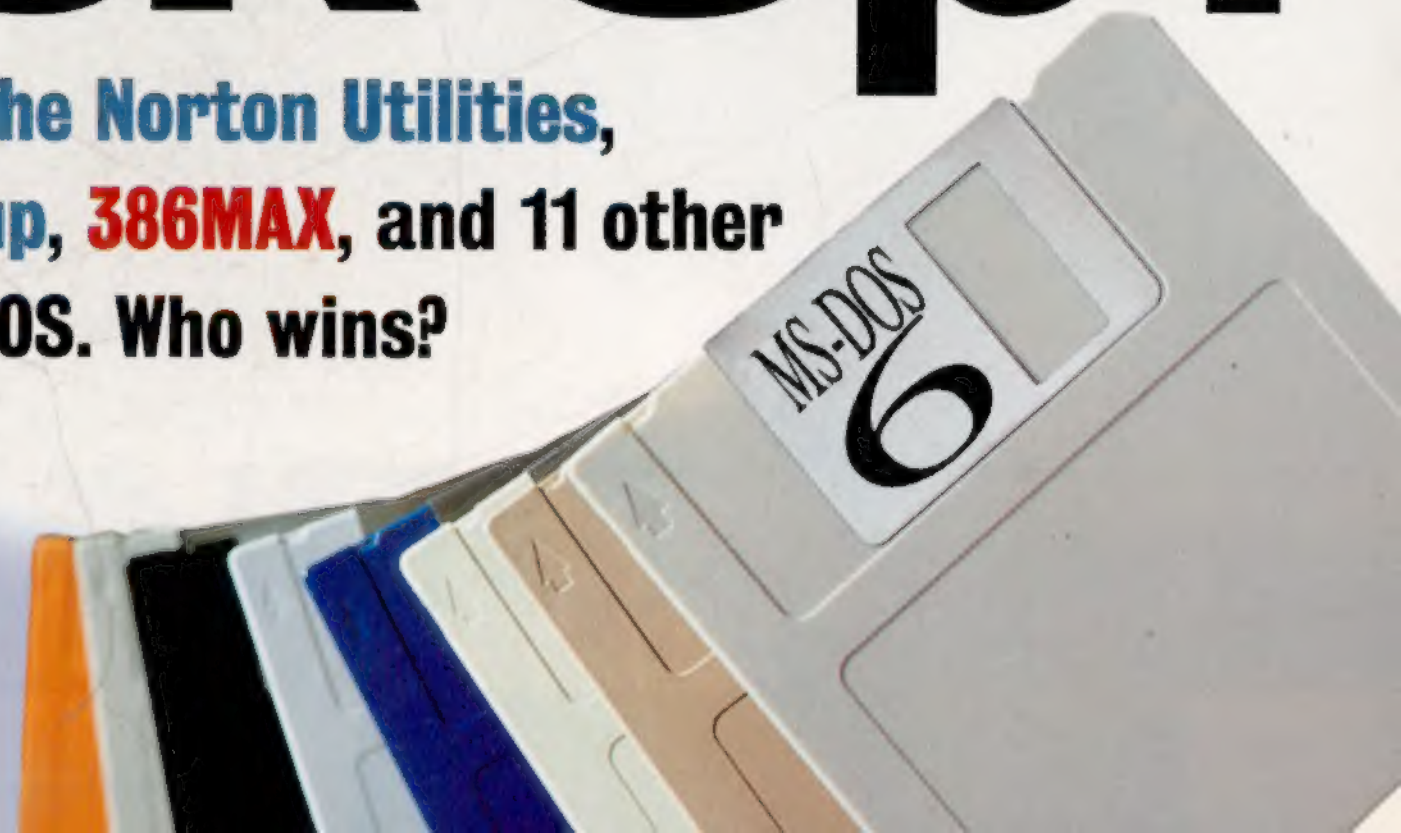
FIRST LOOKS:

2 Major Updates—
PageMaker 5.0
Plays Catch-up;
WordPerfect 6.0
Breathes New Life
Into DOS Word
Processing

Big Monitors:
PC Labs Tests 34
17-Inch Displays

THE BEST UTILITIES: How Does DOS 6 Stack Up?

New versions of Stacker, The Norton Utilities, QEMM, Central Point Backup, 386MAX, and 11 other utilities take on the new DOS. Who wins?



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Inside

Periodically, we undergo a changing of the guard at *PC Magazine*. In this instance, we welcome a new publisher, Jim Stafford, and bid farewell to Jeff Ballowe, who moves up to oversee all the paid circulation magazines at Ziff-Davis Publishing, the division of our parent company which includes this magazine.

Jim Stafford is a *PC Magazine* veteran. Group vice-president of Ziff-Davis's direct magazines, which include *Computer Shopper* and *Windows Sources*, he started his career in the company in 1986 as advertising district manager in the Midwest.

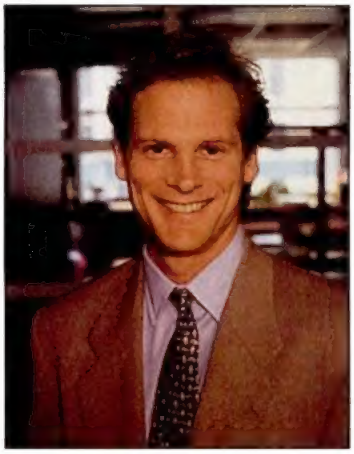
"The market is changing faster than ever, and *PC Magazine* has the commitment and the resources to stay on top of it," says Stafford. He's seen lots of change in the market over the past few years, and that rate of change is only increasing.

That fits in well with how we view change at *PC Magazine*. We know that complacency is dangerous in an industry where "old" means what you're using on your PC today and "new" is a product with no firm ship date.

The concept of the PC platform has been expanding recently, based on new kinds of microprocessors and new operating systems. We're broadening our focus to include these new platforms while still paying close attention to the mainstream PCs based on Intel-compatible CPUs.

But the heart of the magazine continues to be comparative, labs-based reviews, and Stafford is a big supporter of this concept. "It's never been more important to have a resource that helps buyers make informed purchasing decisions," he says. But if our mission remains the same, our approach has to evolve. We're working constantly on new versions of our benchmark tests, Suitability to Task scripts, and general presentations of results. In plain English, we have to change with the market to remain the *PC Magazine* you expect. Our new publisher is committed to these goals and we look forward to working with him. Welcome aboard, Jim.

—*Joel Dreyfuss*



New publisher Jim Stafford

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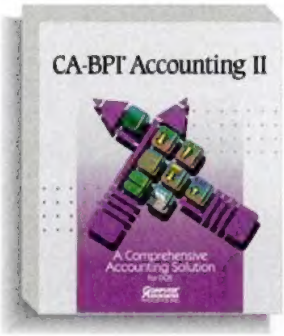

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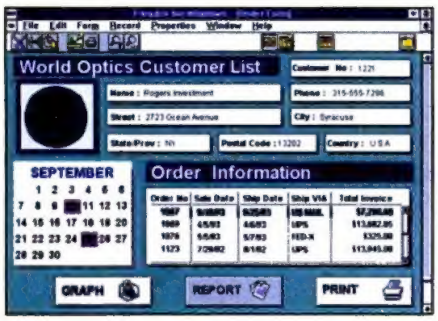

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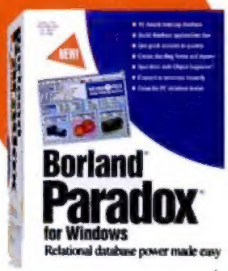

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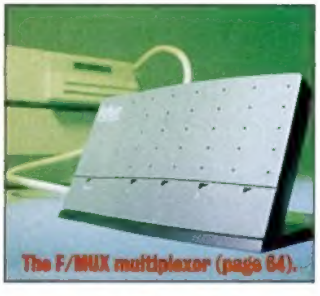

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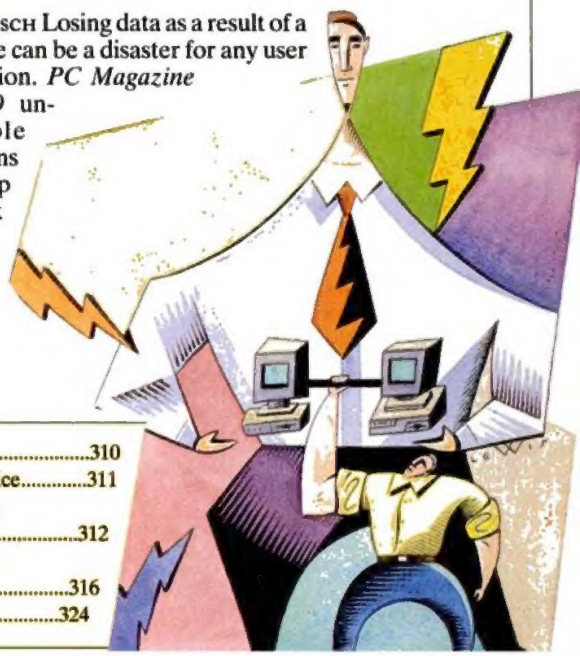

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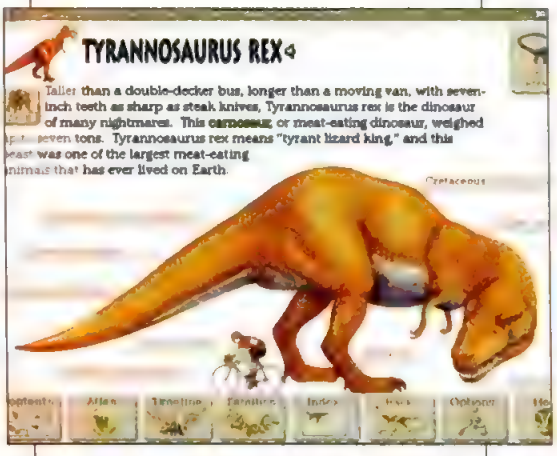

Dinosaurs may no longer roam the planet, but they're coming to a PC near you (page 496).

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Can ACME Corp. survive this terrifying onslaught? See page 500 to find out.

The HP 4L isn't bad, but

THE HP 4L

There's only one option on the HP 4L. A memory upgrade from 1MB to 2MB.

The HP 4L is a good laser printer. Just limited.

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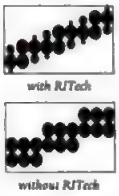
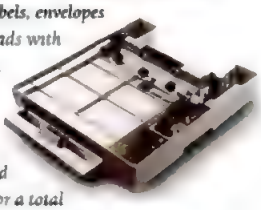
it's no ActionLaser 1500.



Epson's RITech (Resolution Improvement Technology) increases the ActionLaser's normal 300 dpi print quality to eliminate jagged edges right where you need it: in the curved lines of letters, numbers and images. And Epson's MicroArt printing technology gives you deep, dark blacks and incredibly fine lines.

27 fonts (13 scalable) are standard. Should you expand your typographical horizons, unlimited fonts are easy to install via HP-compatible plug-in cartridges, available anywhere. The HP 4L doesn't accept HP's cartridges.

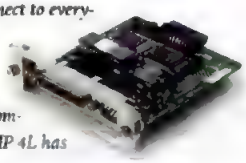
The ActionLaser has 150 sheet paper capacity (letter or legal), and handles stacks of labels, envelopes and overheads with ease. And there's an optional 250 sheet auto-feed cassette, for a total of 400 sheets. The HP 4L holds 100 sheets. Envelopes, labels and overheads are manually fed, one at a time.



The ActionLaser 1500's top speed is six ppm. That's seriously fast, fifty percent faster than the HP 4L.

If you have a DOS machine, but decide to get a Macintosh, do you need a new printer? Not with an ActionLaser 1500. Just add our EpsonTalk interface and your Mac plugs right in.

The ActionLaser 1500 comes standard with parallel and serial interfaces that allow two users to share a single printer. Add another interface and a third user can share the same printer. The ActionLaser 1500 can connect to everything from PCs to IBM mini and mainframe computers. The HP 4L has one interface.



THE EPSON ACTIONLASER 1500

It's easy to add more memory. Just pop in inexpensive, industry standard DRAM chips, for a maximum of 5 MB. The HP 4L only goes up to 2 MB.

PCL 5 is standard. The extra power of Adobe PostScript is a simple plug-in option. With HP, you have to buy another printer to get PostScript.

PC Computing Best Buy. (June 1993.) The word is getting around. The Epson ActionLaser 1500 is the best choice in personal lasers.

The ActionLaser 1500 comes with Epson's limited two year warranty. HP offers one year. For help, call the Epson Connection. Quite possibly the best help line in the business. And it's free.

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PC Magazine does not accept unsolicited manuscripts. We will pay $50 for Solutions and Programming user tips and for Abort, Retry, Fail? submissions. If you submit artwork or newspaper clippings with Abort, Retry, Fail?, mark up the photocopy, not the original.

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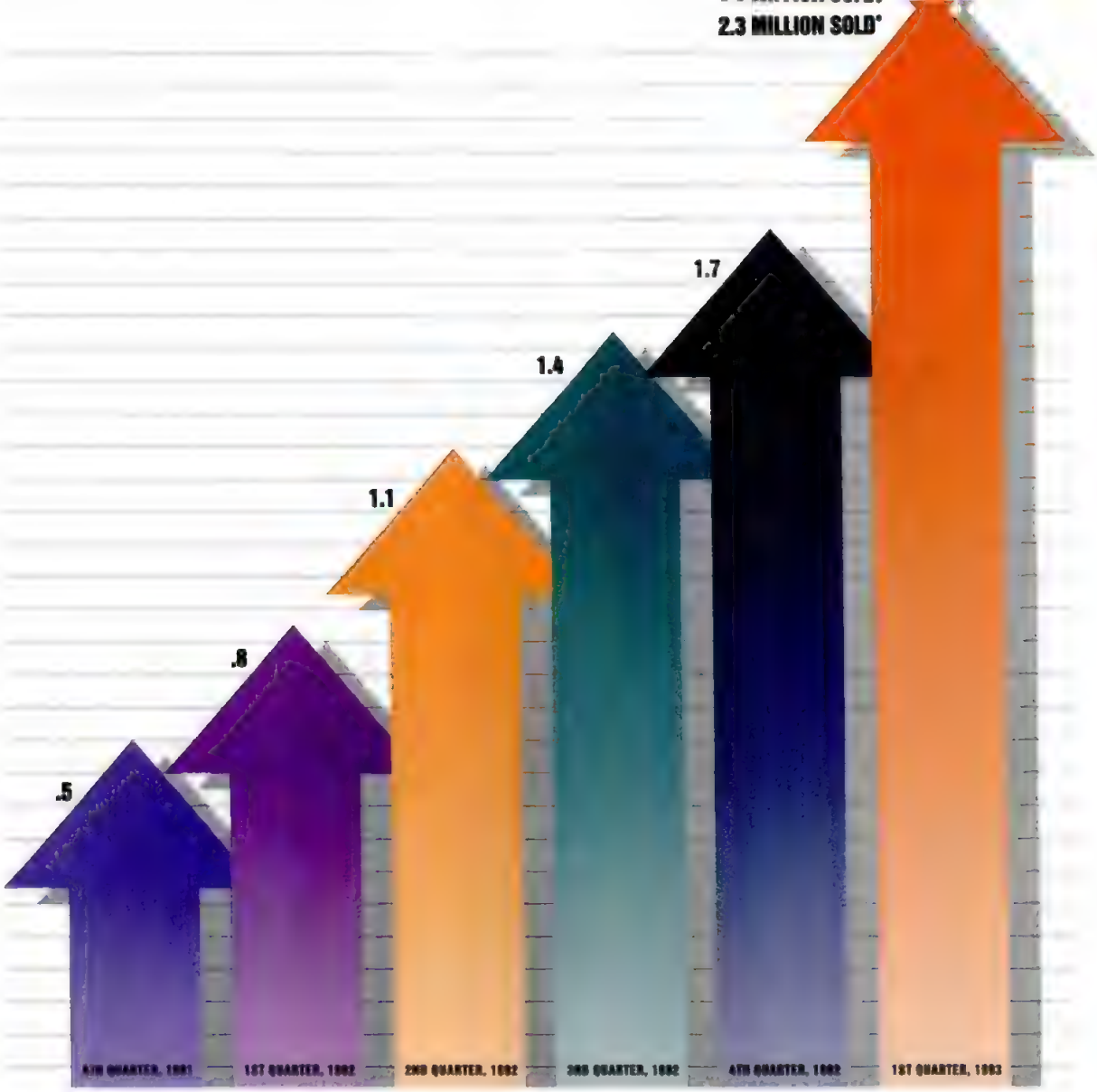

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People learned to like Windows. But with WordPerfect®5.2 for Windows, it's definitely love at first sight. Not only has no software product — not even Windows itself—ever sold more at the start. With 51.2% of first-quarter sales, it's now the biggest selling Windows word processor. What's more, WordPerfect 5.2 for Windows offers advanced new features like Grammatik® 5 (the #1 grammar tool), Adobe Type Manager (with 12 new fonts) and DDE and OLE support. Powerfully improved zoom edit and drag-and-drop. As well as innovations you'll find nowhere else: QuickFinder, a versatile indexing and text retrieval system, mail enabling, QuickMenu, a one-click shortcut to Button Bars,™ and ExpressDocs, for automating documents or forms. But we haven't forgotton what's made us the sales leader. Release 5.2 is still fully file-compatible with WordPerfect 5.1 for DOS and Windows. And it's still backed by the best toll-free support in the business. So call WordPerfect today at (800) 526-2310 for details, or to order the ExpressDocs upgrade for your previous version. Better yet, just visit your favorite local reseller.

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Power supply. 24 watts	Save power. Help save the earth
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Hard disk drive 120MB PCMCIA (2.01) slots. 4 Type I's or II's or 2 Type III's	Lots of room to grow, stretch, connect and add new capabilities

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Ergonomics everywhere. Flicker-free screens. Brilliant colors. Borderless. Two-part keyboard is truer to your hands and habits. With unique TrackPoint II™ pointing device built in. Point it where you want the cursor to go. Works like the tip of your finger. Welcome to *natural computing*.

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Use it with existing applications and networks. Or as a stand-alone. Either way, it's in a class by itself. Can form follow function to truly enlightened design? Absolutely. Just watch PS/2 E lead the way.

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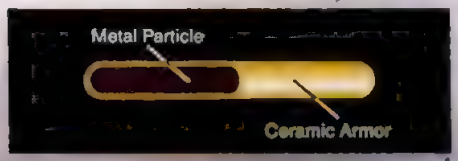

Advanced Tape Design

When it comes to tape design, Maxell continues to break new ground in 4mm technology with a new hublock mechanism called Safe-T-Lock.™ This new feature ensures that your tape spools remain slack

Few things can survive the

free by keeping the hubs positively locked during transportation and handling. As a result, you're assured of proper tape tension when backing up.

Maxell also takes 8mm recording to a new level by introducing an all new coating formulation. This means higher durability, higher output, and the lowest error rates of any manufacturer. There just is no better 8mm data recording product on the market.

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CIRCLE 387 ON READER SERVICE CARD

Protection From Things You Can't Even See.

In Mr. Magoo's case, what he can't see covers lots of territory. For the rest of us, it includes things like invisible electronic emissions.

The more electronic equipment you work with, the greater the concern. That's why some monitor manufacturers offer models with VLMF (Very Low Magnetic Field) features. And charge extra for them.

But not Samtron. We were among the first to offer VLMF on our monitors. And now we build it into every advanced monitor.

For this, Samtron's extra charge is zero.

Another thing you won't see on these monitors is flicker. That's because they're built with non-interlaced technology.

It's a difference even Magoo can appreciate. Take our new flat-screen 15" color monitor (SC-528DXL), for example. Together with a fine-grained 0.28 dot pitch and 1,024 x 768 high resolution, it gives you a picture that is not only steady, but crisp and clean.

The same can be said of our economical 14" color monitor (SC-428TXL). Both are VGA and VESA compatible.

As we said, they all come with VLMF. Plus something else worth looking for.

The reliability of the Samtron name.

SC-528DXL (15")

Advantages Anyone Can See

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New two year warranty applies to products purchased after July 1, 1993

CIRCLE 296 ON READER SERVICE CARD

Letters

VIDEO CARDS: MORE THAN SPEEDY

I appreciated your July 1993 review "How Fast Is Fast? Video Cards Revisited," and the information you presented went a long way toward clearing up the speed issue. But as you indicated in your introduction, there is more to a video card than raw speed. For me, a difference of a fraction of a megapixel or a few seconds across four applications is less important than the assurance that I'm not going to waste hours wading through bad documentation. When the performance difference is slight, the real issue becomes reliability and features.

Stephen E. Trask
Mechanicsburg, Pennsylvania

THE PERFECT ISSUE

Congratulations on your July 1993 issue highlighting "The Perfect PC." It provides decision makers with valuable insights into purchasing and evaluating systems. The accompanying article on service and reliability makes the issue a collector's item.

Jong Sereno
Ann Arbor, Michigan

THE MISSING THREAD

In his July 1993 column, "Windows and Multitasking: A Long Time Coming," Charles Petzold praises Windows NT for having a function that allows one thread to kill another thread, and then writes, "Why OS/2 did not—and still does not—have such a function is one of the great mysteries of our age." Actually, DosKillThread has been around ever since the 32-bit version of OS/2 was released well over a year ago.

Joseph C. Krupp
Springfield, Virginia

WE ALL MAKE MISTAKES

I'm a relative neophyte when it comes to computers, and I've made stupid, silly, frustrating mistakes. But what's the purpose of John C. Dvorak's June 29 column, "Crazy Mistakes: 1993 Edition?" To most people, a virus is a medical condition, and a fixed disk is a repaired disk. I've had an entire telephone conversation based on the confusion of what a backslash is— \ or / ? I need someone to help me learn, not someone to tell me how funny I am.

Richard Epp
Vancouver, B.C., Canada

Graphics Hardware

Video Cards Revisited

What video board should you buy? We look at how well the leading graphics accelerators perform under Windows.

As you indicated, there is more to a video card than raw speed.

V.32bis MODEMS

Thank you for what is by far the most complete and exhaustive review of V.32bis modems to date ("Life in the Fast Lane," June 29, 1993). And thanks to Bill Howard for touching on the advisability of using 16550 UART with these high-speed modems in his June 29 column, "The Trouble with Communications."

Bill Hirsch
Issaquah, Washington

Your modem roundup was indeed impressive, but when I got to the bottom line, I found the picture confusing. Three of the four Editors' Choice winners had unimpressive positions on the Price/Performance Index. If the index is meaningful, it seems that any modem selection other than the Practical Peripherals PM14400FXMT requires detailed defense. Perhaps more information on the weightings assigned to specific features and to the performance ratings of each modem would make it possible for readers to make their own overall ratings on the basis of their priorities.

Joseph H. Gilbreth
Birmingham, Alabama

MODEM VENDORS TAKE NOTE

Bill Howard was right on the money in his June 29 column, "The Trouble With Communications." I'd like to add some things to his idea of optional status lights for internal modems. How about a modem reset button so you don't have to reboot the entire system to reset the modem? And perhaps you can mount an internal modem display in an empty floppy disk drive bay. It would provide plenty of room for status lights and maybe even a small LED text display. Heck, why not add a volume control for the modem speaker? I'd buy that setup in a second.

Michael Haggerty
Springfield, Massachusetts

CHIME IN WITH A 48-BIT SYSTEM

In the June 29 Letters section, Mark Fleming asserts that the AS/400 "is the only multiuser, multiprocessing, 48-bit commercial system on the planet." Unisys's A Series product line has had precisely those features for years since its inception as Burrough's Large System Line. Furthermore, applications written for A Series systems will run on anything from the smallest to the largest system in the line.

Tim Ruddick
Princeton, New Jersey

A WORD FROM THE TRENCHES ON DOCUMENT MANAGEMENT

Being an MIS director at a Mezzanine site, I was concerned with your review "Document Management: The Painful Transition" in the June 29 issue. To say that Mezzanine limits enterprises to adding 10,000 new documents a day to the system is misleading. The system allows for multiple-server installations, thus providing the ability to add an unlimited number of documents per day with seamless access to all servers. Prudent network

Ever since he started designing AST servers, the closest Alex has gotten to *the SEA* is his bottle of *Old Spice*.

There are still a few of us for whom the decision between an afternoon sailing and one spent perfecting a network server is not so clear cut. Perhaps we are a little obsessed with protecting your information. But look at the results: the award-winning AST Manhattan™ SMP and Premium SE Servers. Built into each of our servers are redundancies that make them the most secure place this side of Fort Knox for storing and processing your data. While their upgradability and open architecture will deliver outstanding performance for today's – and future – computing needs. The AST Manhattan SMP and Premium SE network servers. Two more reasons why AST has become a *Fortune 500* company with sales of over $1 billion. And why you won't be seeing an AST regatta anytime soon.

AST. COMPUTER

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AST NETWORK SERVERS

RELIABLE

The Manhattan SMP features error correction-code memory and optional dual power supplies. While the Premium SE's ASIC designs reduce components.

Available fault-tolerant disk array technology using RAID. You'll also find SCSI backplanes that allow hard-drive "hot swap" replacement on both servers.

SUPPORT

Three-year on-site warranty standard. Available 7-day, 24-hour service with 2-4 hour response times.

UPGRADABLE

Depending on model, you'll get either 32-bit or 64-bit architecture, up to nine available EISA expansion slots, 16 drive bays, and 32GB of storage.

Up to six i486™ CPU cards with Intel Pentium™ processor provisions. Up to 256KB cache. The Manhattan SMP also features fully symmetric multi-processing for maximum performance scalability.

OPEN

Compatible with and support for SCO UNIX, Novell, Banyan. Compatible with all industry-standard peripherals, including FastSCSI-2.

RESPONSIVE

To learn more about the LAN Magazine *"Product of the Year" Manhattan SMP and our Premium SE Servers, just call 800-876-4AST.*

SEAWORTHY

A 32' Finla wood sloop. Built in Finland in 1956, it features teak decks and a mahogany hull. All optional, of course.

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management would indicate that if you were adding documents at a rate of 10,000 per day, you would want to split the volume across multiple servers.

It is also incorrect to say that Mezzanine is overkill for all but the largest user site. We are using Mezzanine successfully at our smaller installations.

Katherine De Bruyn
Seattle, Washington

SOUNDING OFF

We at Creative Labs appreciate your review of the SB16 sound board in your April 27, 1993, review, "Sound Boards: Coming of Age." Unfortunately, the distortion levels that you reported for the SB16 are higher than the norm by 300 percent to 1,900 percent.

The SB16 is a multiple-use sound board with four gain levels: x1, x2, x4, and x8. Other boards do not have gain levels because their performance has been optimized at a single gain setting. For a configuration comparable to other boards, the SB16 should have been tested at a gain of x1 or x2 instead of x4. Although the SB16 should out-perform other boards at x4, the differences would have been more dramatic had the tests been performed at x1 or x2.

Gary Davenport
R & D Manager
Creative Labs Inc.

• In order to produce 1 volt of output, which is what we believe you should expect from electronic devices that provide an unamplified (preamplified) signal, we tested the SB16 at a higher gain setting. Unfortunately, at higher gain settings, distortion also increased.—Ed.

SOME USERS WILL NEVER UPGRADE...

I still use WordPerfect 5.1 even though I have WordPerfect 6.0. WP 6.0 is such a radical change from 5.1 that it's more like a new word processor than an upgrade to an old one. It would be easier to use 6.0 if you'd never used WordPerfect before than to make the transition. The interface is unfamiliar and the function keys are confusing. My guess is that WordPerfect will have to issue a major fix, or at least a special manual for upgrade customers explaining all the changes.

Jack Allen
Pacific Palisades, California

...OTHERS WILL UPGRADE PARTIALLY

Your June 29 First Look of XyWrite 4.0 calls it the essential upgrade for XyWrite loyalists. My advice is, don't throw away XyWrite III. Version 4.0 is essential, but only to take advantage of fancy typefaces. Most of us, though, will simply be writing documents and letters that we'll print on a dot matrix printer. While today's word processors present an overwhelming array of buttons, many of which the user never needs, XyWrite III's clean screen can't be beat. If I need to import a graphic, I'll use XyWrite 4.0, but I'll do the majority of my word processing in XyWrite III.

Richard B. Diffenderfer
Summit, New Jersey

It's time to put pressure on developers to include a list of files written to the hard disk during installation, their functions, and any changes to configuration files.

WHAT ARE ALL THESE FILES?!

I'm appalled by the lack of respect that software developers show for my hard disk real estate. I'm willing to live with "Fatware" for Windows, but I draw the line at shelling out money for third-party uninstall utilities. It's time to put pressure on developers to include in the documentation a list of all files written to the hard disk during installation, their functions, and any changes to configuration and .INI files. I think this is preferable to application-specific uninstall utilities since it gives more control to the user.

John Amy
Toronto, Ontario, Canada

A STORY OF EXCELLENT SUPPORT SENT OVERSEAS

I live overseas and bought a Dell notebook while on vacation in the U.S. After returning home, I found that the unit would shut down suddenly and indicate that the battery was discharged even though it wasn't. Dell told me to send the notebook back for service, but considering the customs duties and shipping costs, I did nothing.

Fourteen months later I was in the U.S. on another vacation, and I decided to call Dell because I was sick of using only the AC adapter. Even though my notebook was no longer under warranty, someone at Dell listened to my story, diagnosed my problem, and eventually authorized the shipment of a new part to my vacation address, all for free. When I got home to my notebook, the same Dell representative talked me through dismantling the system and installing the new part. Sure enough, the unit works perfectly. Dell's service makes me a lifetime fan.

Victor R. Sagis, Jr.
Terengganu, Malasyia

CORRECTIONS AND AMPLIFICATIONS

In our July 1993 review of system reporting software, "Taming Your IRQs," we printed an incorrect toll-free number for Dariana Software, makers of WinSleuth Gold and System Sleuth Professional. The correct number is 800-892-9950.

In our July feature "The Perfect PC," under the heading "Upgrading Your RAM and CPU," we printed an incorrect toll-free number for Kingston Technology Corp. The correct number is 800-435-2620.

HOW TO WRITE TO PC MAGAZINE

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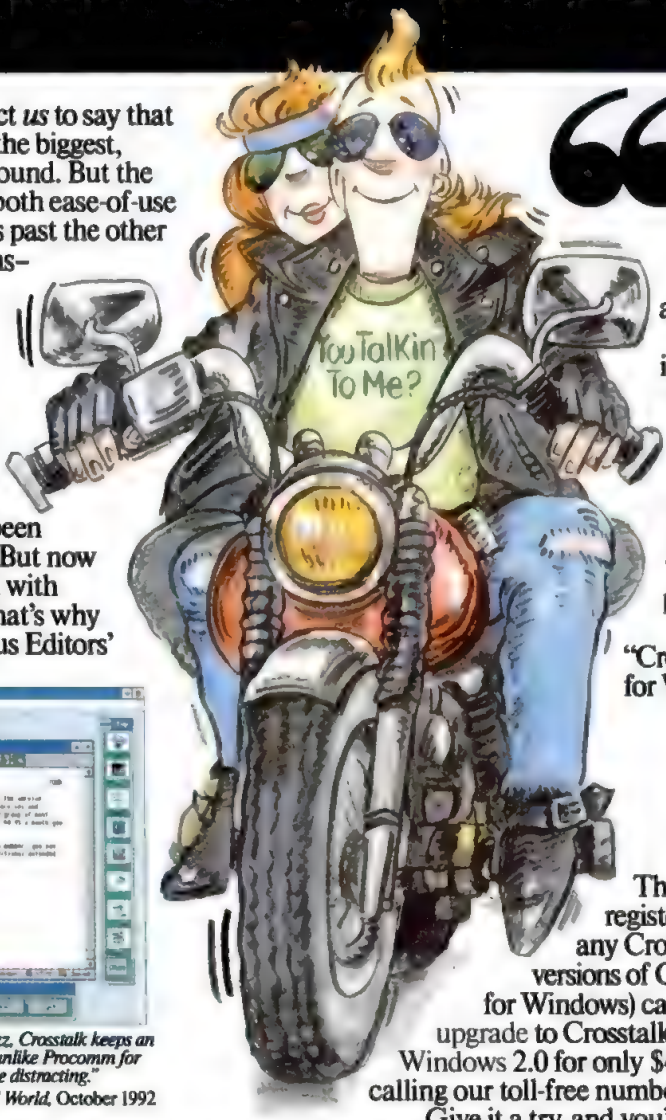
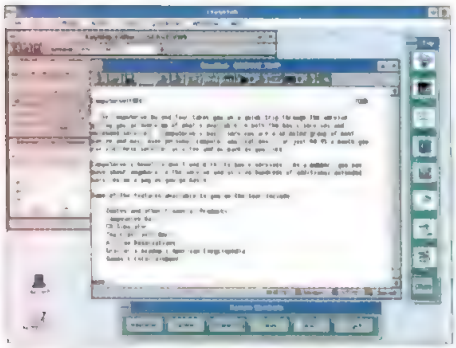
The Leader Of The Pack In Windows Comm Software.

Naturally, you'd expect *us* to say that Crosstalk® for Windows is the biggest, baddest comm software around. But the experts agree with us: For both ease-of-use and power, Crosstalk blows past the other Windows™ comm programs–including Procomm Plus® for Windows.



Easy-To-Use Rider.

Crosstalk has always been known for its horsepower. But now all that power is combined with tremendous ease of use. That's why *PC Magazine*, in naming us Editors' Choice for the second year in a row, said, "This package has changed a great deal since last year, when it earned our Editors' Choice Award. But it has changed only for the better."



"Even with all the added interface pizzazz, Crosstalk keeps an air of clean, no-nonsense functionality, unlike Procomm for Windows, which offers enough glitz to be distracting."
—*PC World*, October 1992

Crosstalk Leaves The Competition In The Dust.

Fact is, if you're ready for a Windows comm program, there are two products you're most likely to consider: Crosstalk for Windows and Procomm Plus for Windows. And reviewers have been clear about their preference.

PC Magazine called our interface "elegantly designed" while noting that with Procomm Plus for Windows, "so many non-essential elements remain on-screen during terminal sessions." And *Windows Sources* commented that Crosstalk, "unlike Procomm for Windows, provides a full screen for sessions." *InfoWorld* summed it all up: "Crosstalk is stronger than Procomm for Windows." Nuff said.

> *Crosstalk covers all bases with its sophisticated scripting for high-end users and quick on-line access for novices. This rich package is suitable for any environment....*
> —*PC Magazine* Editors' Choice, April 1993

Ride With The Leader.

Through November 30, 1993, registered users of Procomm Plus or any Crosstalk product (including earlier versions of Crosstalk for Windows) can upgrade to Crosstalk for Windows 2.0 for only $49, by calling our toll-free number.

Give it a try, and you'll fall for the leader of the pack. And yes, we *are* talkin' to you.

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That Great Things C

Less than 4 pounds, yet runs Windows!

Intel 386SL or 486SL CPU

486SL version has local bus video for Windows acceleration!

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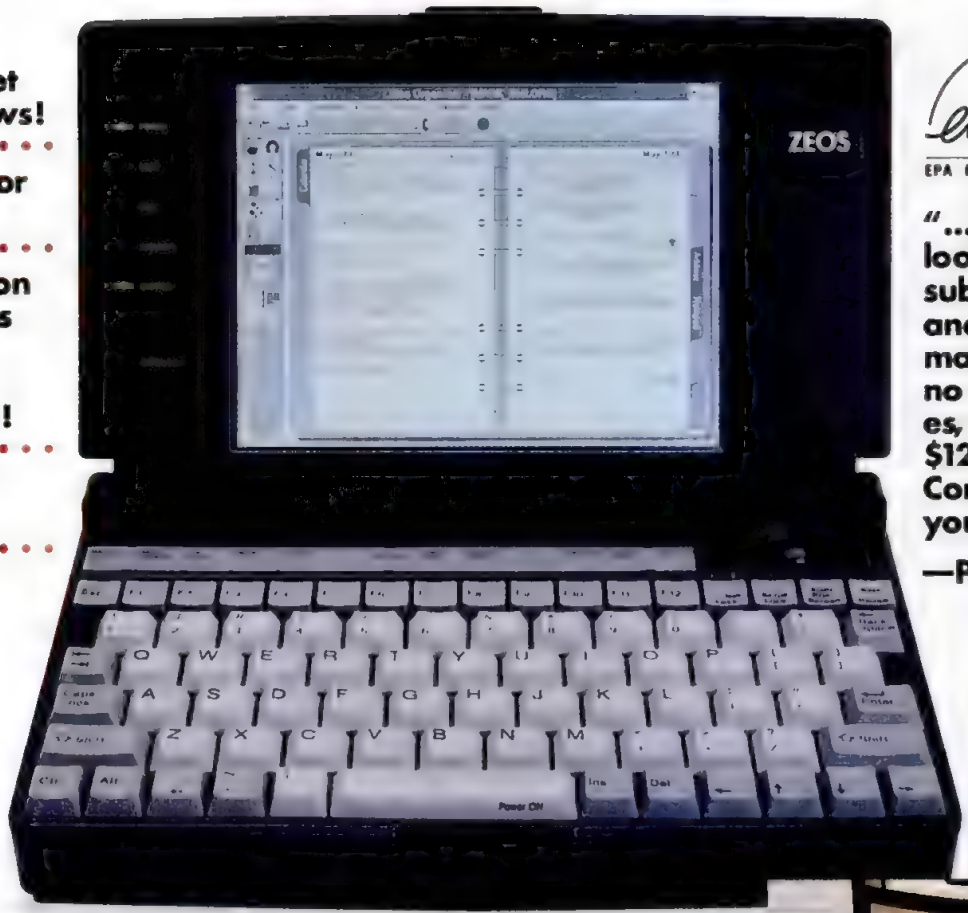

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"...if you're looking for a subnotebook and want to make next to no compromises, then the $1295 ZEOS Contenda is your best bet."

—PC Week

Smaller than a notebook. Lighter than your briefcase. The ZEOS Contenda subnotebook is proof that great things come in small packages...including plenty of power to run Windows wherever you go!

We start with a smart Intel SL processor —your choice of either a 386SL-25 or new 486SL-25. You'll find that the Contenda's processor extends your battery life significantly—because it's intelligent enough to power-down the memory, disks, modem and more when they're not in use.

What's more, the Contenda's features make it a pleasure to use. Features such as a high-resolution backlit screen that's crisp and vibrant. A built-in trackball so you won't have to tote a mouse around. And with a standard 80MB hard drive, memory up to 10MB and weight of less than four pounds, it's one powerful, portable Windows workhorse!

nda.™ Solid Proof
me in Small Packages.

PACKAGE 1

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Lease: $59/month
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486SL Contenda: $1795
Lease: $66/month
- 4MB RAM
- 80MB IDE hard drive

PACKAGE 2

386SL Contenda: $1595
Lease: $62/month
- 4MB RAM
- 80MB IDE hard drive
- External 3.5" floppy disk drive
- MS-DOS 6.0
- Microsoft Windows 3.1
- Lotus Organizer

486SL Contenda: $1995
Lease: $73/month
- 4MB RAM
- 80MB IDE hard drive
- External 3.5" floppy disk drive
- MS-DOS 6.0
- Microsoft Windows 3.1
- Lotus Organizer

FAVORITE OPTIONS

ACCESSORIES
External 3.5" floppy disk drive **$99**
Extra battery **$99**
External charging stand **$79**
Custom leather carrying case **$129**
Custom nylon carrying case **$79**
DC-DC adapter **$49**

MEMORY UPGRADES
386SL: 2MB to 4MB upgrade **$99**
386SL: 4MB to 10MB upgrade **$561**
486SL: 4MB to 8MB upgrade **$198**

COMMUNICATION
FastLynx File transfer software **$79**
Internal 2400 bps modem with 9600 bps send fax and 4800 bps receive fax **$99**
Xircom Ethernet adapter (10BT or Coax) **$349**

PACKAGE 3

386SL Contenda: $1795
Lease: $69/month
- 4MB RAM
- 80MB IDE hard drive
- External 3.5" floppy disk drive
- Custom nylon carrying case
- Extra battery
- Internal 2400 bps modem with 9600 bps send fax and 4800 bps receive fax
- MS-DOS 6.0
- Microsoft Windows 3.1
- Lotus Organizer

486SL Contenda: $2395
Lease: $87/month
- 8MB RAM
- 80MB IDE hard drive
- External 3.5" floppy disk drive
- Custom nylon carrying case
- Extra battery
- Internal 2400 bps modem with 9600 bps send fax and 4800 bps receive fax
- MS-DOS 6.0
- Microsoft Windows 3.1
- Lotus Organizer

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CIRCLE 334 ON READER SERVICE CARD

The Daily Me

Laying out tomorrow's (electronic) news.

This morning, you probably read the daily news. Five years from now, you're likely to do the same. Only instead of unfolding a newspaper to get the latest headlines, you'll be looking at a flat-panel display—perhaps one that's built into your commuter train. Even better, the stories themselves will be more interesting—because they'll be about topics you're interested in. You'll be looking at *The Daily Me*—tomorrow's news as seen through the eys of researchers at the Massachusetts Institute of Technology's Media Laboratory.

These folks started thinking about "convergence" long before the concept become popular. Back in 1978, Nicholas Negroponte, then an associate professor in MIT's architecture department, began persuading the university to dedicate a new lab to studying the areas in which publishing, broadcasting, and computing overlap. In 1985, he got his way, and the lab opened.

Today the Media Lab's primary focus is News in the Future, a project launched formally in May. Its goal is to explore new ways of gathering, filtering, and delivering news. It's funded largely by publishing companies (including *PC Magazine*'s parent, Ziff-Davis Publishing Co.) that get first crack at its discoveries.

Despite the corporate sponsorship, academia reigns. Conversations tend to the philosophic in the house that I.M. Pei built.

"We're very anti-McLuhan here," says Walter Bender, the project's principal research scientist. "We believe the *message* is the message. The challenge is to extract it from the medium, to transcode it from one medium to another." A key tenet is that information must be accessible whether it's displayed on the large, full-color, high-res screen in your living room, or on the mini LCD strapped to your wrist. One aspect of accessibility is to make information more personally relevant. A personalized newspaper would send you articles about the stocks you own, the companies you compete with, the places you're about to visit.

A growing number of companies are starting to address what a paperless newspaper will look like. Just about every major paper is already on-line. Knight-Ridder's *San Jose Mercury News*, available through America Online, even supplements the full text with related stories. And access software is improving. The most promising package to come along recently is PED Software Corp.'s $129.95 Journalist, which lets you get articles off CompuServe's news feeds and lay them out like a customized newspaper (408-253-0894). *The Daily Me* doesn't seem so far off after all.—*Mary Kathleen Flynn with Melissa J. Perenson*

OLE by Committee?

THE ONLY THING IN THIS INDUSTRY that changes faster than standards are the secret code-names for some of them. A case in point is OpenDoc, an offshoot of what was formerly code-named Amber; before that, Exemplar; and before that, Jedi. The names refer to the various incarnations of an Apple-based software architecture that allows users to create compound documents containing information and media from many applications. With newfound support from Borland, IBM, Novell, and WordPerfect Corp., OpenDoc could well throw a monkey wrench into Microsoft's compound document architecture, Object Linking and Embedding (OLE).

OpenDoc is sort of an OLE 2.0 on steroids. Like OLE, OpenDoc offers in-place (also called in situ) editing and object linking and embedding, but the architecture also accomodates far-reaching standards for document management, a cross-platform scripting language, and a consistent user interface for embedding objects in documents.

The biggest difference between OpenDoc and OLE is that OpenDoc was designed to work across platforms—Macintosh, OS/2, Windows, and ultimately Unix. OLE, was developed primarily as a way to provide applications integration on standalone Windows-based machines. OpenDoc supporters pledge they will maintain strict compatibility with OLE 2.0.

WordPerfect Corp.'s recent push on multiple platforms dovetails nicely with the OpenDoc initiative. For Novell, OpenDoc steps up its competitive strategy against Microsoft. IBM will use OpenDoc in OS/2 and the WorkPlace OS—the company's SOM (System Object Model) will be the underlying architecture for OpenDoc. Borland, a long-standing cheerleader for object-oriented programming, will build OpenDoc into its tools and apps.

The big question is whether or not a committee of competitors can be as effective as the streamlined Microsoft machine.
—*Robin Raskin*

Illustrations by David Bamundo

Pipeline *By Robin Raskin*

Two Roads Diverge

Robert Frost thought he had it bad when "two roads diverged in snowy woods." At least his roads weren't still under construction. Our problem is considerably thornier.

This month marks the end of the long-standing IBM and Microsoft Joint Development Agreement, the cross-licensing agreement that allowed the two companies to exchange source code and share Windows and OS/2 technology. IBM's ability to use Windows 3.1 source code in its operating system was a kingpin to the success of OS/2's Windows compatibility box. Not only will IBM no longer enjoy this preferential status, but in all likelihood, Microsoft will quickly move to institute a number of changes to its operating system that will stymie OS/2's Windows compatibility. By this winter, the operating system landscape could look more frigid than it does today.

Because so much of the 1992 amendment to the initial Joint Development agreement has not been disclosed, we're forced to piece together a "he said/she said" to figure out which road might be safer. IBM and Microsoft agree that all code (for Windows only, not Windows NT), even code under development, is fair game and can be shared through September 17, 1993. Theoretically this means IBM could grab a good bit of Chicago—the 32-bit version of Windows due next year.

IBM claims it is not interested in any of Microsoft's 32-bit code. IBM spokespeople say that they have what they need—the right, in perpetuity, to use 16-bit Windows code in all IBM products. You'll also hear them claim to have the rights to do derivative works, and to clone existing APIs. But don't be swayed by legalese. Every third party gets the same deal. You can hook into Microsoft's APIs—you can even clone them, provided you don't infringe on patents or intellectual property—but only Microsoft can evolve them. IBM can wait to see which 32-bit Windows API becomes a dominant player and then reverse engineer it by mapping the calls to its own 32-bit OS.

Meanwhile, Microsoft claims technology, and not any hidden agenda to squash OS/2, is what drives the company to incompatibility. "IBM believes we spend a lot of time to make their lives difficult", says Tony Audino, formerly director for operating systems at Microsoft, now in charge of MS-DOS. "What we try and do is push the envelope of a product. Sometimes that means making it less compatible with existing products."

It's clear that both Chicago and the next version of DOS will have a new file system and enhancements that will render them incompatible with OS/2. And while Microsoft can easily stay compatible with itself, the various 32-bit works in progress don't offer any clear cut migration path. The flavors of 32-bit Microsoft APIs— Win32s, Win32c (Chicago), Win NT, Cairo—fragment a once-unified Windows market. Microsoft has not been able to clearly define the segments. The end of the IBM/MS agreement is one more indicator that we stand at a fork in the OS road.

Many of us will opt to sit at the fork until the road work is done.

Robin Raskin is an executive editor of PC Magazine.

Software Vending Machines

TRADITIONALLY, RETAIL SOFTware is distributed in stores and by mail order, while shareware is distributed by catalog disk vendors and on-line services. But the times, they are a-changin'—in several innovative ways.

Rackware, economically-packaged shareware and low-cost retail software that is generally hung on display racks, was pioneered by SoftKey and other companies a decade ago. But the marketing practice has become ubiquitous only in the last year or so. Now just about every airport, department store, and computer retailer carries at least one rack. Most rackware falls into entertainment and educational categories, but that too is changing as major apps begin to appear. Some rackware lines offer retail software with traditional publisher royalties; others sell shareware requiring registration if you find the product useful.

Rackware isn't the only innovation in software distribution. Two years ago, The Pearl Agency in Germany and other companies in central Europe developed "software vending machines," an idea that has migrated across the Atlantic and will soon debut in the United States. These machines in grocery stores and other neighborhood shops let you view a demo or product description. To buy, you purchase a specially formatted disk, onto which the vending machine copies your selection.

PCVend machines from Winn-Mack services are now seving up shareware in over 50 locations in Canada (800-263-5749). Customers can choose from almost 10,000 shareware titles stored on CD-ROM and pay a charge of $1 to $4, to copy the software onto their own disk. Taking another lesson from abroad—this time, Brazil—stateside companies such as Shareable Software International in suburban Chicago are sealing deals with disk suppliers such as Memorex, Dysan, and Sony to distribute a free "11th disk" in a 10-pack of blank disks. The extra disk contains a mass-appeal retail or shareware title.

What's next? Perhaps fully functional software on "cover disks" attached to magazines, a popular idea in Britain. Visual Basic, Symphony, and SideKick have appeared in recent months, along with incentives for related purchases from their publishers.

—J.W. Olsen

PCVend machines dispense self-serve shareware.

Photograph by Keith Beaty

DRAM Drought

IF IT'S NOT ONE THING IT'S ANOTHER. Even as the cost of a 486 processor slips, a worldwide shortage of DRAM memory chips is driving up the basic cost of a fully configured PC. Brought on by stronger than predicted PC sales, the demand for DRAM has gone from a healthy growth curve to a frantic search for additional suppliers. The DRAM drought can only spell bad news for the adoption of Microsoft's Windows NT and IBM's OS/2 2.1—both of which require loads of memory to run optimally.

While most U.S. companies stopped making DRAMs in the late 1980s because they didn't want to pour money into what looked then to be a small-margin business with too many competitors, companies in Japan invested heavily in DRAM foundries and now account for the lion's share of 4MB DRAM production—the mainstay of the market.

Top-tier system makers have protected their prices because they buy DRAM chips on a long-term contract, with a specific price and delivery date. Smaller manufacturers and companies whose demand outstrips supplies are forced to buy on the spot market, where DRAM prices can cost up to three times as much. A typical spot market price for 4MB DRAM is now $15, up from $11. 16MB DRAM, still in tight demand, costs considerably more. Since most DRAM is manufactured in Japan, the yen's appreciation against the dollar has added an additional 10 to 15 percent to the price of Japanese DRAM.

Protectionist forces are at work, too. Earlier this year, the U.S. Commerce Department imposed tariffs ranging from 1 to 5 percent on DRAM chips sold into the United States by Korean manufacturers on the grounds that those companies were selling below cost. Micron Technology, which brought the charges, is one of the few U.S. companies still in the DRAM business.

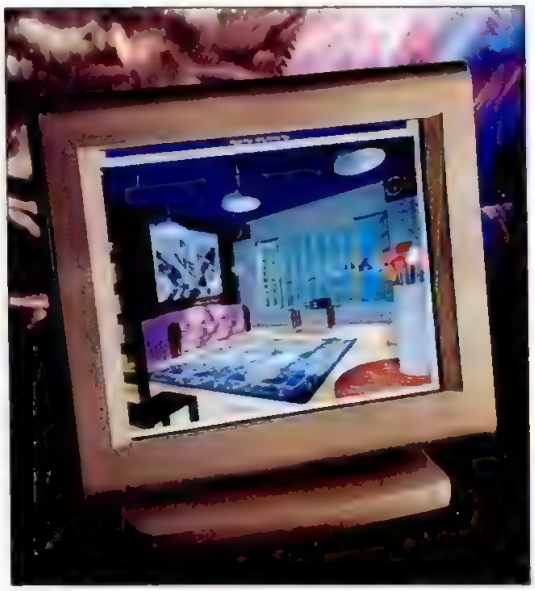
Because of the massive amounts of money required to ramp production, the shortage is not likely to end soon. Research firm InfoCorp predicts many users will buy PCs with the minimum memory configuration rather than pay the high price of additional DRAM.

The lack of adequate (or affordable) RAM on PCs may stunt the growth of memory hog operating systems and applications that require megabytes of RAM. Microsoft's Windows NT will require 12 MB of RAM with 16MB recommended. If users have to pay more for RAM simpy to run NT, some may choose to wait until RAM prices drop.
—Christopher Barr

Top Retail Software

Current ranking	Last Issue	Product company
1	--	**Lotus 1-2-3, Release 4 for Windows Upgrade Kit** *Lotus Development Corp.*
2	--	**WordPerfect 6.0 for DOS Upgrade Kit** *WordPerfect Corp.*
3	1	**MS-DOS 6.0 Upgrade Kit** *Microsoft Corp.*
4	13	**Access for Windows 1.1 Upgrade Kit** *Microsoft Corp.*
5	--	**OS/2 2.1 Upgrade Kit** *IBM Corp.*
6	--	**CorelDRAW 3** *Corel Corp.*
7	4	**WordPerfect 5.2 for Windows** *WordPerfect Corp.*
8	--	**WordPerfect 6.0 for DOS** *WordPerfect Corp.*
9	--	**Stacker 3.1** *Stac Electronics*
10	--	**PrintCache 3.1** *LaserTools Corp.*
11	--	**WinFax Pro 3.0** *Delrina Technology*
12	--	**Procomm Plus for Windows 1.02** *Datastorm Technologies*
13	--	**Procomm Plus 2.01** *Datastorm Technologies*
14	13	**Paradox for Windows 1.0** *Borland International*
15	--	**HiJaak PRO 2.0** *Inset Systems*

This list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending July 3, 1993. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and cannot be interpreted as a picture of the entire software market. Sales information compiled by Ingram-Micro.



NEC hopes its analog panel will replace bulky monitors.

Perfect Panel

COLOR ACTIVE-MATRIX LCD PANels for notebooks became available only last year and quickly rose to the top of the list of preferred options on higher-end portables. Now the demand for color is so strong that by the end of the year, at least one major notebook maker will offer only color in its executive-class machines, relegating monochrome to its value-price line.

Another notebook maker, NEC Technologies, (one of a handful of companies with an active-matrix LCD panel foundry in Japan), recently showed a prototype low-power LCD panel that could hasten the replacement of bulky desktop CRT monitors with flat-panel displays. The 12.9-inch diagonal screen has a resolution of 1,280 by 1,024 pixels, and can produce 24-bit true color (more than 16.7 million colors).

The difference between NEC's prototype and other high-resolution active-matrix panels shown by IBM and Sharp is that this one is analog; the others are digital. A digital interface means the panel requires special drivers to make more than 4,096 colors, or 256,000 colors. Since it's analog, NEC's panel can be connected to a standard video connector on any computer and provide spectacular color.

The product won't be ready for 18 months, but in the future, LCD panels will be used for VGA monitor replacements where space, power, and radiation emissions are a problem. By the end of the century, all the major VGA display manufacturers expect LCD panels to replace bulky desktop CRT's. Glass tube-based VGA displays will then be sold for very high-end, super-fine resolutions to do CAD_CAM, publishing, and image editing, or as inexpensive entry level desktop systems. But these LCD panels are not cheap. Considering that each prototype NEC panel uses nearly 4 million transistors to make all those color pixels, the price of each unit should be equal to a Rolls Royce—if you have to ask what it costs, you probably can't afford it.
—Christopher Barr

Photograph by Howard Bjornson

VESA Goes Green

WHEN IT COMES TO MAKING COMPUTER equipment more energy efficient, the Environmental Protection Agency's Energy Star program started the ball rolling. The movement is gaining momentum as the Video Electronics Standards Association nails down an energy-saving standard for monitors, expected to be widely implemented by year's end.

VESA officials say the proposed Display Power Management Signaling (DPMS) standard will conserve more energy, reduce emissions, and increase the life span of cathode-ray tubes (CRTs). And VESA hopes the standard will encourage more monitor manufacturers to join the EPA's Energy Star program, which requires monitors to power down to less than 30 watts when they are not in use. Although the EPA sets energy limits for displays it doesn't specify how vendors should meet the requirements.

VESA's DPMS will establish standard combinations of horizontal and vertical synchronization signals to be communicated by a PC's graphics controller or board to the display. The spec will provide for four power stages: On, Stand-by, Suspend, and Off.

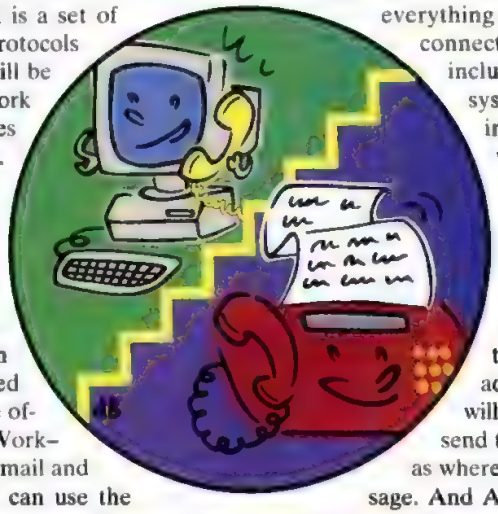
Two of the largest players in the monitor market, NEC Technologies and Samsung Electronics America, have both announced intentions to comply with the VESA spec. IBM Personal Computer Co.'s new PS/2 E system will include a 14-inch DPMS-compliant monitor. ADI Systems will introduce its own compliant 17-inch unit this fall, as well as manufacture one for Compaq. And MAG InnoVision will ship a DPMS-compliant 21-inch monitor this fall. ATI Technologies, Cirrus Logic, and Intel are all supporting the spec, ensuring that graphics boards and controllers will also comply with DPMS.

Since monitors use even more energy than PCs, DPMS will be essential to reducing the power draw on your desktop.
—*Brad Stilwell*

At Work Extends The Network

IF MICROSOFT CAN GARNER SUPport for its At Work architecture, then sending a fax from your PC may *really* be just as easy as printing someday. Think of it. You just select Send, and a familiar dialog box pops up that handles the formatting and the addressing of your fax. End users won't have to worry about what kind of fax modem is installed on their PC, and fax vendors won't have to write device drivers for the plethora of interpretations of the various fax hardware standards.

That's because one of the cornerstones of At Work is a set of communications protocols and services that will be standard in all At Work devices. All devices must be able to 1. *send and receive digital documents,* and 2. *connect and talk to one another.*



One possible scenario involves a remote office with At Work–enabled phones and a home office with At Work–enabled network e-mail and fax machines. You can use the remote office phones to send messages to the home office that can be received by e-mail or by fax. Since the messages will be digital, they can be edited, and since they will be "rich digital," they will include all of the format codes that exist in the original fax document.

Of course, At Work also includes communications services that are specific to particular devices. Some services that are needed by telephony are useless to a networked printer. What is obvious from the suggested scenario, though, is that our concept of the "network" will be extended considerably. In the At Work office, not only does the network now include everything with a fax modem connected to it, but it also includes the telephone system. It's hard to imagine a network with a longer reach than the phone system.

Microsoft envisions the system working intelligently. All you will have to do is select an address and At Work will know exactly how to send the message, as well as where to deliver the message. And At Work will send it either the fastest way or the cheapest—based on what priority you assign to the message.

The communications services software is now in beta test, and hardware that supports it will be available later this year. How will we know when and if Microsoft has succeeded? When it works, we'll know.—*Rick Ayre*

Briefs

TOSSING OUT YOUR CREDIT CARDS MAY BE the traditional first step in controlling personal finances. But the new craze is free money-management software. Computer Associates started the fad when it offered to give away one million copies of Kiplinger's CA-Simply Money. Now, Intel is bundling a free copy of Intuit's Quicken 2 for Windows in its SatisFAXtion modems, available through retailers.

TO ENCOURAGE USERS TO BACK UP THEIR data, 3M has established The Data Preservation Awards. The awards, also sponsored by user groups including the Association of Personal Computer User Groups (APCUG), will honor individuals who have created outstanding data backup and protection policies for their organizations. (Call 800-888-1889, extension 33, for nomination forms.)

THE NEXT TIME YOU GET PAGED, THE message may not come from a colleague. It may come from your storage system. Storage Dimensions's new LANStor Plus driver software for NetWare networks includes DiskAlert, which notifies system managers of disk crashes and other storage-related problems via pagers, beepers, and workstation messages. (800-765-7895.)

COMPANIES KEEP DETAILED INFORMATION about most assets they own—cars for example. But ask about their PCs, "and they look blank," says Timothy Poley, executive director of the PC Assets Management Institute, which was formed to help companies manage their technical resources. Annual memberships start at $295 and include a bimonthly newsletter, quarterly reports, and access to a toll-free hotline. (1-800-722-6487.)
—*Mary Kathleen Flynn*

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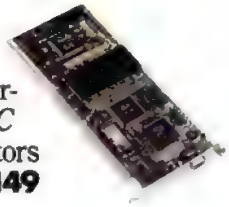

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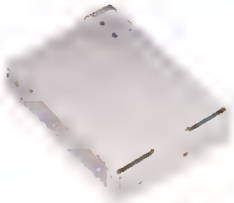

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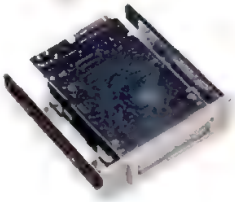

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486SX-25

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- Choice of Windows application

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PACKAGE #2:

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- 214MB local bus hard drive with built-in 128K cache
- Windows-accelerated local bus video
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486DX-33

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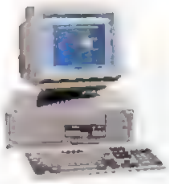

486DX2-66

PACKAGE #3:

- 8MB RAM
- 426MB local bus hard drive with built-in 128K cache
- Windows-accelerated local bus video
- SVGA color monitor
- Both floppies
- DOS, Windows, Mouse
- Choice of Windows application

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486 DX2-66

PACKAGE #3 PLUS:

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486 DX2-66

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486 DX2-66

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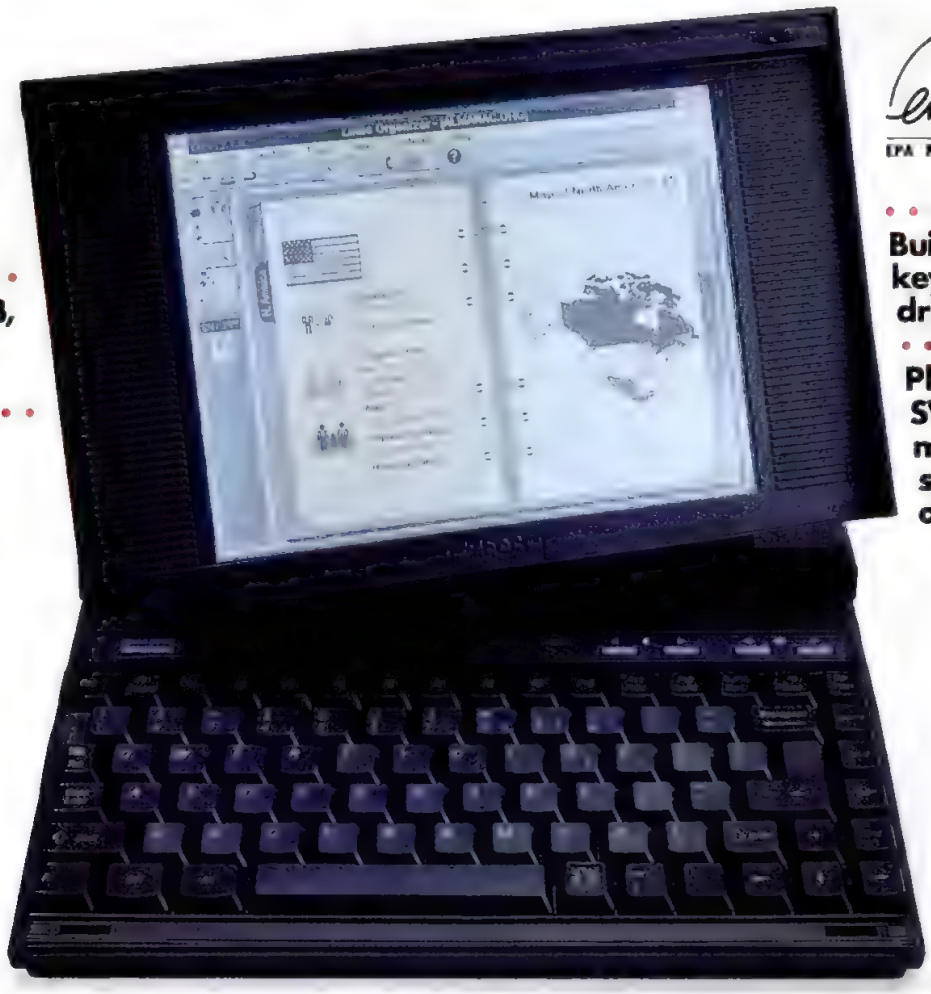

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- Microsoft Windows 3.1

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- MS-DOS 6.0
- Microsoft Windows 3.1

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First Looks

HANDS-ON EVALUATIONS OF THE NEWEST SHIPPING PRODUCTS

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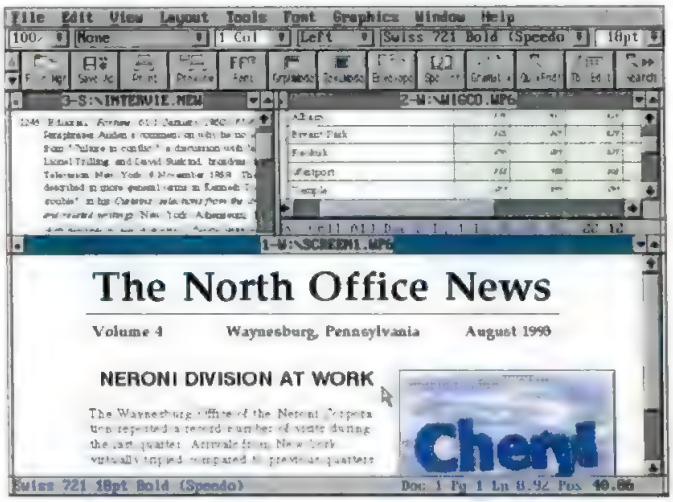
WordPerfect 6.0: DOS Word Processing Like Never Before

BY EDWARD MENDELSON

WordPerfect 6.0 for DOS combines the efficiency of a DOS word processor with the luxuries usually found in a suite of Windows programs: WYSIWYG editing, a built-in spreadsheet, support for four scalable font formats, sound recording/playback, hypertext, fax support, and an advanced macro language.

WordPerfect Corp.'s $495 (upgrade $129) flagship program is the most powerful application ever written for DOS, with a graphical editing screen that produces page layouts that even Windows desktop publishing programs can't duplicate. But you can also configure it to look and work almost exactly like character-mode WordPerfect 5.1.

WordPerfect now offers three different mouse-enabled editing screens: fast text mode; slower graphics mode, with more exact representation of fonts than is offered by Windows; and slowest page-mode, which displays headers, footers, and footnotes along with the main text. Pull-down menus are optional, and you can assign the text and graphics screens different combinations of format ribbon, button bar, and scroll bars. An uneditable print preview displays single pages or, if you can stand the wait, up to 255 pages as individual thumbnails.



WINDOWS LIKE WINDOWS: *WordPerfect 6.0 does multiple windows.*

AUTOMATED PROCEDURES

The program walks you through merges and lets you select merge records either manually or automatically. An automatic envelope feature gives you the option of including bar codes. Tables

Continues on page 40

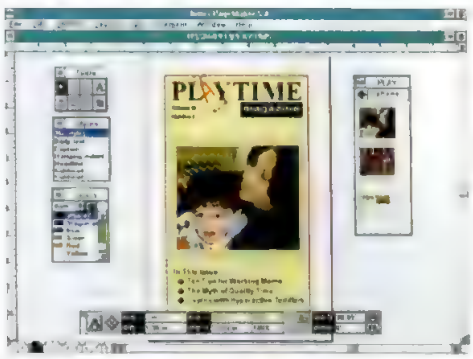
■ **Desktop Publishing**

PageMaker 5.0 Struggles to Stay Competitive

BY LUISA SIMONE

PageMaker 5.0 is like the proverbial glass of water that is either half empty or half full—expectations are everything. If you expect an improved interface or four-color separation tools, you won't be disappointed with this revamped $895 desktop publishing program.

If you expect PageMaker 5.0 to handle text with greater control or with automated effects, however, you should be prepared for a halfway implementation that will leave you thirsting for more control over the type in your documents.



ROTATION: *Turn any text or picture 360 degrees.*

Where PageMaker's interface is concerned, all the news is good. The program has several new floating palettes that are reminiscent of those in QuarkXPress. The Control palette comes in two flavors: text and objects. With them you can manipulate just about every aspect of your page layout. For example, in addition to repositioning and resizing objects, the new Control palette lets you rotate objects in one-tenth of a degree increments, flip elements, and skew both text and pictures. The new Library palette lets you store, catalog, retrieve, and even perform keyword searches on frequently used elements.

Version 5.0 lets you open multiple documents simultaneously and has drag-and-drop functions. Not only can you drag

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PC Labs Special Report

OS/2 2.1: Good Performance, Improved Hardware Support

BY RICK AYRE, AMARENDRA SINGH, AND DON WILLMOTT

Chances are you've heard quite a bit about OS/2 2.1. In fact, *PC Magazine* took an in-depth look at a prerelease version of IBM's operating system ("OS/2 2.1: IBM's 32-Bit Challenger Revisited," June 15, 1993) in which we analyzed the long list of OS/2 2.1's enhancements: support for Windows 3.1, OLE, and TrueType; improved SVGA, SCSI, and multimedia drivers; the inclusion of a 32-bit graphics engine; and more.

But what about OS/2's performance, compared with OS/2 2.0 and with Windows and DOS? Is OS/2 a *faster* DOS than DOS and a *faster* Windows than Windows? And just as important, what about compatibility? How are all those new drivers and features playing in the real world? To find out, we put the final OS/2 2.1 code through a rigorous series of benchmark tests we codeveloped with our colleagues at the UK edition of *PC Magazine*.

DISK THROUGHPUT

First, we looked at hard disk throughput. Our OS/2 Disk Performance test showed OS/2 2.1 to be slightly (but consistently) faster than OS/2 2.0. OS/2 2.1 demonstrated better throughput on both reads and writes, no matter what the size of the data transfer, and whether the action was sequential or random. The 5 to 10 percent increase in throughput helps make OS/2 2.1 feel faster overall.

This improvement in disk access, slight though it may be, is an impressive accomplishment because disk access in 2.0 was quite good, and the hard disk was never touted by IBM as a place where performance gains were needed or targeted. More than anything, the better disk access demonstrates IBM's willingness to continue to tweak OS/2's speed wherever it can, and that's a good sign.

GRAPHICS TESTS

OS/2 2.1 didn't measure up to expectations on our OS/2 Graphics Performance test. We were counting on OS/2's new 32-bit graphics engine to improve graphics performance. Instead, as our test report shows, overall performance was better under OS/2 2.0.

What our result doesn't explicitly indicate is that while overall performance was better under 2.0, most of the individual routines that make up the graphics test were, in fact, faster under OS/2 2.1. Of the 14 individual tests, only two were faster under OS/2 2.0; one of them, the text-handling test, accounts for most of the difference that makes OS/2 2.0 look so good relative to 2.1 on this test.

Since OS/2 2.1 is faster than 2.0 on most of the drawing tests, it's likely that drawing-intensive real-world applications will prove to be faster under 2.1, though you may still be disappointed in the level of improvement over 2.0.

REAL-WORLD GOOD NEWS

If you choose to use OS/2 as a tool for multitasking DOS and Windows applications, you'll be well served. Our real-world application tests show that OS/2 2.1 does a much better job of running Windows and DOS apps in compatible WIN-OS/2 and DOS sessions. In testing, OS/2 2.1 ran Windows applications as fast as Windows 3.1 did, and DOS applications ran even faster than they did under DOS alone.

OS/2 2.1 blew away OS/2 2.0 on our Microsoft Excel test, finishing the routine in less than one-third the time that 2.0 took. Looking at this result alone, it's hard to believe that Versions 2.1 and 2.0 are even related. The Excel test also shows that OS/2 is now evenly matched to Windows itself. Remember, this is not a simple recalc test. The macro-driven routine includes recalculations as well as graphing, charting, cell formatting, and worksheet printing. The entire test is based on profiles of what people really do with spreadsheets, and therefore closely approximates the performance you can expect when you run in one of these environments.

Equally impressive was the performance of Paradox 4 for DOS running under OS/2 2.1. As you can see from the results, our Paradox test ran faster under OS/2 than under Windows 3.1, and just about as fast as in DOS itself.

OS/2 2.1: A Fan's Notes

by John C. Dvorak

OS/2 will be the power user's operating system for the next couple of years. Only Windows NT is a threat, but until NT is proven to have the same power, OS/2 2.1 is the system to use no matter what they tell you. I use it exclusively for my work.

When you start using OS/2, you have to get past the fact that it exemplifies simplicity and complexity at the same time—a concept little understood by nuts-and-bolts fogies. OS/2 is easy to use and almost designed with the beginner in mind. Just point and click, or, if you'd rather, go to a DOS-like command line. But OS/2 can be complicated, too. Under the surface are DOS session settings, multiple desktops, complicated notebook settings—all for customizing and fine-tuning the system. Many of these nitpicky settings can be appreciated only by a Unix hack, but you can always just ignore them.

For someone who likes computers, OS/2 brings fun to the desktop. And it really performs. OS/2 lets you do everything at once, and you never lose control of the machine. If some program runs amok you can shut it down without disturbing the rest of the system. It's amazing how weeks and weeks go by without you ever having to reset or reboot your computer.

On the downside, running OS/2 successfully requires a fast 486 with a large hard disk and 16MB of main memory. That's the minimum system as far as I'm concerned. Also, before you install OS/2, make sure you have a compatible video card that OS/2 will run at 1,024-by-786 or 800-by-600 resolution. Swapping out video cards in OS/2 is not trivial.

My feeling is that the popularity of OS/2 will increase dramatically when people finally start to grasp the power of true multitasking. Think about it. As you write in one session, you keep your dictionary open in another window. You cut and paste from window to window, even between DOS sessions! You even have a CD-ROM running in one session while you go online in the background using a simple DOS comm program. It's amazing. Hey, if nobody else uses OS/2, that's okay. I'll have the competitive edge.

The CorelDRAW test turned in less surprising results. The OS/2-specific version of CorelDRAW ran faster under OS/2 2.1 than under 2.0, and the Windows version of CorelDRAW did, as well. Note, however, that the Windows version of CorelDRAW ran faster under Windows than it did under OS/2.

AND YET...

Unfortunately, OS/2 2.1 continues to be somewhat of a stranger in a strange land. It's not as compatible as DOS, and though that's to be expected, its lack of compatibility with particular CD-ROM drives, video boards, SCSI adapters, network adapters, BIOSes, and sometimes entire PCs, may slow down its acceptance (along with the fact that OS/2 apps are still slow to appear). In PC Labs, we've gone through several difficult installations, turning up both esoteric and not-so-esoteric incompatibilities. The bottom line: You have to be extremely careful when you attempt to install OS/2, especially on any system that is outfitted with network cards or multimedia peripherals.

The good news is that device support in OS/2 2.1 is far better than it was in 2.0. The lack of video drivers, one of the biggest complaints about the earlier version, has been partially addressed. While the Service Pack extensions to OS/2 2.0 added driver support for a dozen video chips and video board families based on them, 2.1 has also increased the number by another ten, and additional drivers are available directly from the vendors.

Some, but not all, popular graphics accelerators from companies such as ATI, Cirrus Logic, Diamond, Digital Equipment Corp., Orchid, Tseng Laboratories, and Western are supported, and drivers for S3-based boards are well on the way.

Support for SCSI controllers, for use with both hard disks and CD-ROMs, is also better (but not good enough) and sound board support has been added through the Multimedia Presentation Manager/2, but it's currently limited to certain Creative Labs, IBM, and Media Vision products.

And what about OS/2's continued compatibility with Windows itself? IBM's and Microsoft's Joint Development Agreement ends on September 17, and that raises critical questions about the compatibility of future versions of OS/2 with future versions of Windows (see "Pipeline" in this issue's Trends section).

MAKING OS/2 EASIER

Of course, IBM is doing everything it can to make OS/2 both accessible and serviceable. There are four OS/2 forums on CompuServe, and IBM's National Service Center has its own bulletin board service (404-835-6600) and tech support line. All of these support systems may come in handy if you find yourself grappling with an OS/2 installation.

IBM is also preparing to extend OS/2's usability by coming out this fall with an add-in package that will give OS/2 peer-to-peer networking capabilities for small workgroups. Later, you can expect the technology to be incorporated into the operating system itself.

At this point, it's clear that the next great software revolution requires a 32-bit multitasking, multithreading operating system as its starting point. We'll get there gradually, and OS/2 2.1 is a big step along that path. But as IBM looks to the future, it must also keep an eye on the present, where today's PC users demand and deserve maximum compatibility.

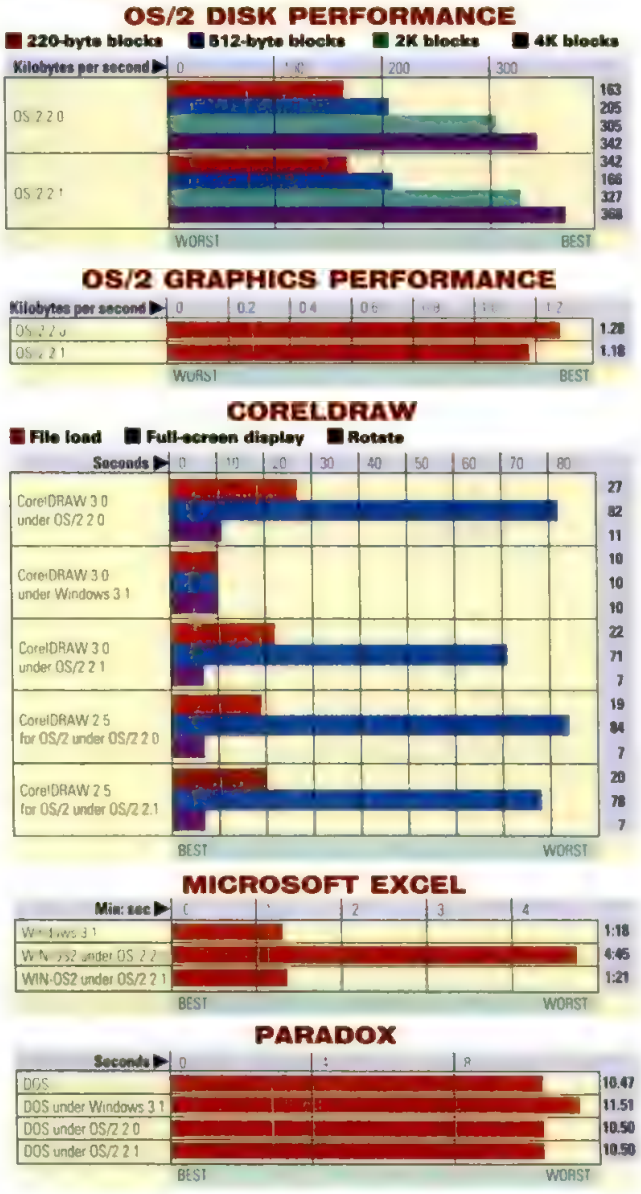
• List price: *IBM OS/2, Version 2.1, $195; upgrade, $119 ($99 for CD-ROM).* Requires: *386SX or better, 4MB RAM (8MB recommended), 60MB hard disk space. IBM Corp., Old Orchard Rd., Armonk, NY 10504; 800-342-6672; 800-465-1234 (international); fax, 800-426-4329.*

Circle 429 on reader service card

Performance Tests: OS/2 2.1

We tested OS/2 2.1 on a 33-MHz, 486-based Compaq Deskpro 4/33M with 8MB of RAM, a Compaq Advanced VGA adapter, and a 340MB hard disk. The first two tests, both OS/2 applications themselves, show disk and graphics throughput. Both are based on the same profiles that were used to create PC Magazine Labs' Hardware Benchmark Tests 7.01 and Winbench 3.11.The **OS/2 Disk Performance** test creates a file on-disk and then reads and writes in different block sizes, both sequentially and at random. The **OS/2 Graphics Performance** test runs 14 different graphics calls. The result reported here is the overall throughput.

The application-based tests measure real-world performance in DOS and Windows compatibility modes under OS/2. Because the results are in seconds, lower scores represent better performance. The **CorelDRAW** test loads a 170K file, displays it in full-screen mode, and then selects all the objects in the file and rotates them 10 degrees.The **Microsoft Excel** test consists of recalc, sort, cut-and-paste, and chart-display operations. The **Paradox** test loads a file, searches for and removes duplicate fields, and reindexes the file before backing up the database.



WordPerfect 6.0

CONTINUED FROM PAGE 37

now include most functions from PlanPerfect, making WordPerfect's tables comparable with those in some early versions of Lotus 1-2-3, although without charting. A "floating cell" feature automatically reproduces the data from any table cell in your text. You can build warm links to spreadsheets, too.

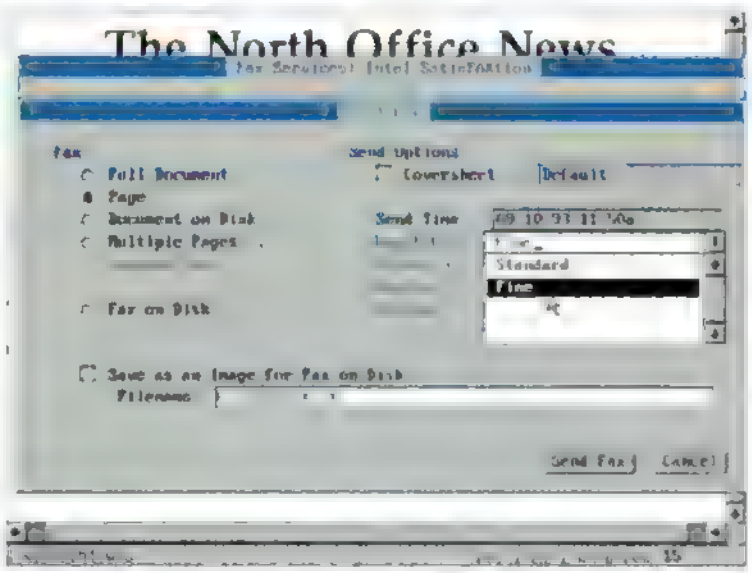
Collapsible outlining can be controlled from the keyboard or with the mouse. Paragraph numbering is confusingly hidden in the outline menu, but includes the unique ability to number paragraphs A1, A2, and so on. Outline and numbering schemes are stored as styles, and styles are more efficient and powerful than in earlier versions.

The new version contains a new bookmark feature that is flawed by the inability to make bookmarks overlap. Hypertext links can jump among multiple documents but are awkward to use in text mode.

MORE LIKE WINDOWS

Some of the new version's features match those in WordPerfect for Windows 5.2. DOS WordPerfect users can now edit nine documents at once, retrieve text with a built-in indexer, and jump to directories from a list of descriptive names. Other features help the new version catch up with rival programs: first-line indents for paragraphs, searches for specific format codes, and loosely integrated grammar checking.

Like WordPerfect's Windows version, the new DOS version allows precise placement of embedded format codes (visible only in an ugly codes window) but also, like Microsoft Word, lets you apply paragraph formatting when the cursor is anywhere in the paragraph. When you apply formatting, WordPerfect places codes at the start (or sometimes at the end) of the paragraph or page where the codes logically belong. When you change formats, the new codes replace the old ones so your files aren't littered by superseded codes. Automatic code placement, like most other new features, can be switched off. You can "delay" codes in order to automate layout changes between the first and later pages.



FAXING: *Transmit directly from the edit screen.*

A GRAPHICAL DOS WORLD

WordPerfect's graphics screen isn't as elegant as Windows, but it lets you drag and drop images and lines. Menus let you scale or rotate graphics, adjust color palettes, apply gradient fills, and automatically contour text around graphics, but there are no freehand drawing tools.

No other program or environment approaches WordPerfect's near-universal font support. The program prints and displays Type 1, TrueType, Intellifont, and Speedo fonts; supports larger symbol sets than Windows; and lets you decide which screen font to use when displaying a printer font. All fonts print on any printer that supports graphics—quickly with LaserJets, more slowly with other models. Thirty scalable fonts come in the package, including outlines of 1,500 different characters. By launching a small terminate-and-stay-resident program before you run WordPerfect, you can fax out your document using any installed font.

WordPerfect is the only PC application that automatically replaces strings like "ff" and "ffl" with the combined ligature characters when printing. This is an undocumented feature that you can access by turning on kerning in the Printer Functions menu.

SMOOTH UPGRADE

The new keyboard layout closely follows the old, although, in another reversible change, F1 is finally the help key. All menus are now dialog boxes with shortcut keys, but you'll have to learn to use arrow or tab keys instead of Enter to move between items. Most menus include a convenient submenu for setting defaults and installing drivers and fonts.

The new version smoothly imports files from WordPerfect 5.1 for DOS or WordPerfect 5.x for Windows, and supports older features such as document math that the Windows version can't recognize. Imported ASCII files are saved in ASCII format by default, so you can edit batch files easily. You can import and export in most major formats, and a batch-conversion program comes in the package. You can save 6.0 files in 5.1 format, but neither 5.1 nor WordPerfect for Windows can read normal 6.0 files.

A new macro language, roughly similar to that in WordPerfect for Windows, will require wholesale rewriting of many complex macros. A supplied utility converts many 5.1 macros, but macros that jump among menus will need retouching. The on-line macro help is too terse, the manual gives almost no guidance, and only a partial macro manual will be available from WordPerfect Corp., probably in early fall. Users who rely on macros may prefer to wait for other macro books to be published before upgrading. Keyboard layouts from 5.1 can't be converted directly to 6.0.

Though WordPerfect 6.0 will run on a 286-based system, a 16-MHz 386 machine is the practical minimum for text mode, and we recommend a 33-MHz 386 for graphics mode. A minimal installation fills 8MB of hard disk space. Not surprisingly, if your hardware is too limited for Windows, it's too limited for WordPerfect's graphics functions.

The new version is generally bug-free, despite some spurious error messages, graphics drivers that lock up on monochrome systems, and Intel fax support that won't work when the system date is July. Some fonts leave annoying specks on the graphical screen, and you can't jump to a header or footnote by clicking on it in page mode. The hand-holding tutorials called "coaches" are unreadable in monochrome. You can expect fixes in the inevitable maintenance release. You may also want third-party alternatives to the under informative manual, which doesn't even tell you which graphics formats you can import.

Overall, WordPerfect 6.0 is a stunning achievement that brings to DOS-based word processing features that no one imagined possible a few years ago. DOS itself may get a new lease on life from this outstanding program. □

FACT FILE

WordPerfect 6.0 for DOS

WordPerfect Corp., 1555 N. Technology Way, Orem, UT 84057; 800-451-5151, 801-225-5000, fax, 801-222-5077

List price: $495; upgrade, $129.

Requires: 480K RAM, 7MB hard disk space (16MB for full installation), DOS 3.1 or later.

In short: WordPerfect 6.0 brings the best of Windows word processors to the DOS world, including thorough font support, true WYSIWYG editing, and multiple document windows.

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CIRCLE 364 ON READER SERVICE CARD

PageMaker 5.0

CONTINUED FROM PAGE 37

an object from one PageMaker document to another, but you can bypass the now-famous Place command by dragging file icons directly from File Manager into a waiting PageMaker layout.

PAIN IN SEPARATION

Earlier versions of PageMaker made generating color separations hard work. Version 5.0 addresses this shortcoming with a host of new color-handling, separation, and production-oriented features. Most impressively, PageMaker can now generate four-color separations directly, provided that the color objects in a document contain the appropriate CYMK information. This means that PageMaker can now import CYMK TIFF files (Version 6.0) and preseparated EPS images in the .DCS (Desktop Color Separations) format. You can even create traps and chokes on an object-by-object basis, or by specifying the Overprint option for individual colors.

Seemingly small features, such as wider support of color matching systems (Pantone, Dainippon, Focoltone, TOYO, and Trumatch); full compliance with the OPI (Open PrePress Interface) specification; and the ability to generate optimized halftones based upon PPD (PostScript Printer Description) files can prevent big headaches when you send your file to a service bureau for final output.

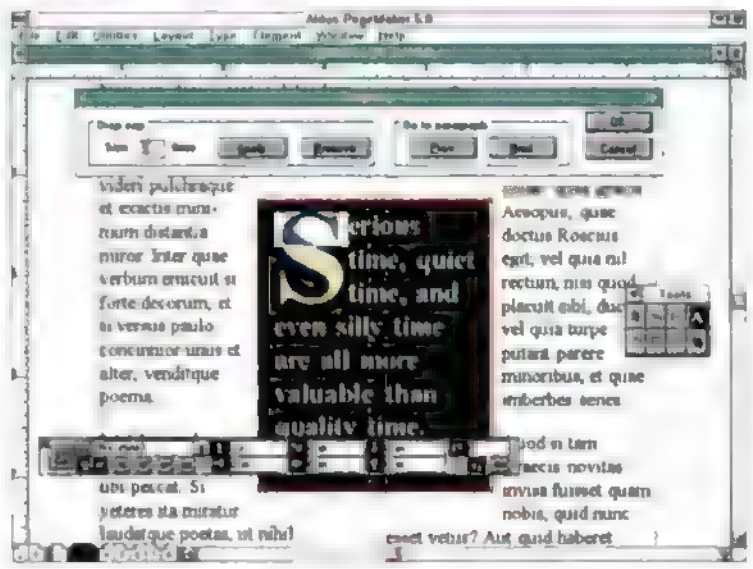
PageMaker 5.0 also includes the Panose font-matching system to handle font substitutions across platforms (to Mac-based service bureaus, for example) and the new version can even convert between the PICT and Windows Metafile formats for embedded pictures.

ALDUS ADDITIONS

Aldus Additions, which can be interpreted macros, compiled macros, or compiled programs, debut on the PC with Version 5.0. PageMaker ships with over 20 different Additions that run the gamut from prepress utilities to layout functions and text effects. And with a copy of the PageMaker 5.0 Script Language Guide (available to registered users), even end users can automate design tasks within PageMaker 5.0.

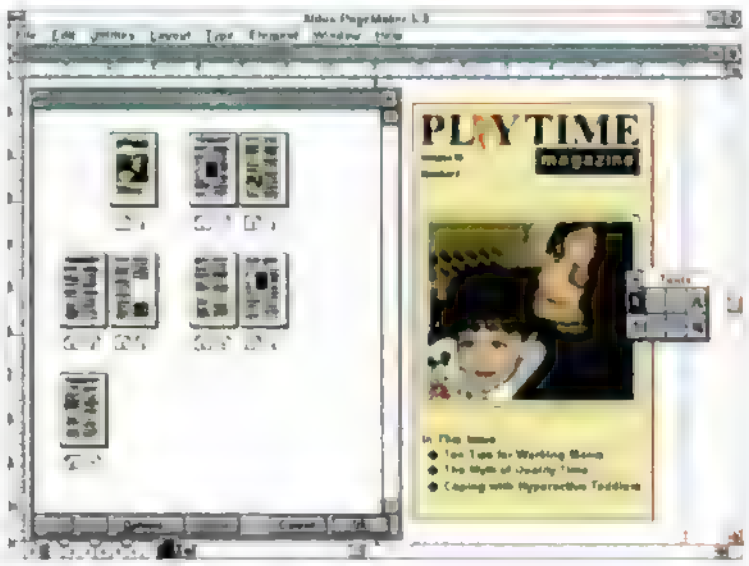
Additions that help you access Twain scanner drivers, reorder the pages in your publication interactively, or create printer-spread impositions are straightforward tools that work as advertised. However, a number of Additions come with caveats and warnings. For example, the new grouping functions, PS Group It and PS Ungroup It, actually convert selected objects into an EPS file that is stored externally, linked to your publication, and accessed at print time. Not only does this approach to grouping create a slew of extraneous files, it only produces high-quality printouts if you use a PostScript printer.

Most frustrating are those Additions that attempt to add text effects, such as drop caps or continued lines, to PageMaker 5.0. Since PageMaker's basic composition engine remains unchanged, the Additions merely automate the text workarounds that are all too familiar to PageMaker 4.0 users. For example, the Drop Cap Addition formats the first character in a paragraph as a subscript (to shift it down) and then inserts soft carriage returns and tabs to wrap the rest of the text around the large letter. Any alterations you subsequently make turn your beautiful drop cap into a mess of misaligned tabs.



ALDUS ADDITIONS: *Lets you automate drop caps.*

The same sort of limitations crop up with a Bullets and Numbers Addition that doesn't let you control indents directly, makes balanced columns that don't stay balanced if you add text, and creates continued lines that can't update the page number if they are moved. In fairness to Aldus, the manual does advise users to employ these Additions only after the rest of the design has been finalized.



SORT PAGES: *Drag thumbnails to new locations.*

HANG ON TO VERSION 4.0

If you want the least painful upgrade path, keep PageMaker 4.0 installed on your system and run it concurrently with PageMaker 5.0. PageMaker 5.0 uses a newer (and not totally compatible) hyphenation dictionary, has redefined the tracking tables, and now measures characters using an internal grid of .05 points. While these changes do result in more accurate text composition regardless of the resolution of the printer, they can also cause inappropriate line breaks in publications that were originally created in Version 4.0. Unfortunately, fixing all of the inconsistencies is a matter of editing each bad line break by hand.

In the course of our testing we experienced two system failures, both of which can be explained—and avoided. In one case, a third-party image-editing program crashed when it could not find a DLL associated with PageMaker 4.0 (the file is also used by Aldus Gallery Effects Plug-In filters). And we found out the hard way that you must use the new PostScript drivers (Version 3.56) that ship with PageMaker to avoid a crash when printing imported images to PostScript devices.

By improving cross-platform compatibility with the Mac, adding color separation capabilities, and providing easier access to its layout tools, PageMaker 5.0 has responded admirably to user requests and needs. But where professional-level design functions are concerned, PageMaker 5.0 is still playing catch-up with its chief competitor. The simple truth is that QuarkXPress can resolve type in finer increments than PageMaker can, and it handles grouping, alignment, and special text formats more effectively.

Paradoxically, it may be those features that have *not* changed since Version 4.0 that make PageMaker a viable contender in the high-end DTP market. Being able to massage spreadsheet and database files during import, automate indexing and table of contents generation, and manage linked files across a network are still compelling reasons to use PageMaker in a corporate publishing environment.

• List Price: *Aldus PageMaker 5.0 for Windows, $895; upgrade, $150.* Requires: *4MB RAM (8MB recommended), 11MB hard disk space, Windows 3.1. Aldus Corp., 411 First Avenue South, Seattle, WA 98104; 800-627-8880, 206-628-2320; fax, 206-343-3360.*

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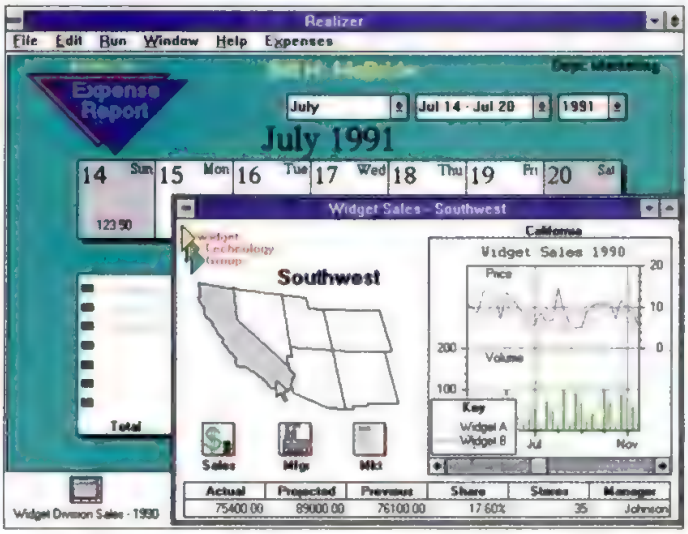

Once an application is complete, you can compile it into a stand-alone Windows application and distribute it royalty-free with the run-time module that's included. And you can generate an installation disk with the push of a button.

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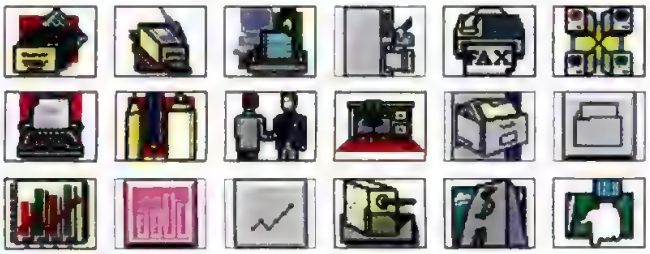
Charts, Spreadsheets, Text Editors, Graphics, Animation, Scheduler	✔	
Ability To Run Multiple Applications Simultaneously	✔	
Full Support For DDE & DLLs	✔	✔
Direct MDI Support & Serial Communications Library	✔	
Import Export Of 1-2-3, Excel, CA-SuperCalc Files	✔	
Extensive Context-Sensitive On-Line Help	✔	✔
Clip Art Library With Over 250 Bitmaps	✔	
QuickBASIC Version 7.0 Compatibility Libraries	✔	



Don't waste another day trying to figure out Visual BASIC. Leave that for your competition.

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CA-REALIZER Release 1.0 and Visual BASIC Release 1.0 compared 10/92. Cost comparison based on Visual BASIC Release 1.0 Suggested Retail Price. *PC Computing* quote appeared 10/91, pg. 90.

CIRCLE 381 ON READER SERVICE CARD

■ The Esperanto of File Formats

Adobe Acrobat: A Common Denominator for Viewing Files

BY LORI GRUNIN

There are plenty of ways to distribute documents electronically, but there are also plenty of problems to overcome, with font handling and cross-platform support presenting the two biggest obstacles to universal compatibility. Adobe Acrobat tackles those problems head on.

Adobe sees Acrobat as a sort of United Nations of compatibility. It's a program through which any kind of document—no matter what graphics and fonts it contains—can pass to become viewable on any Acrobat-equipped computer, no matter what kind of operating system, graphics, or font capabilities that system has.

Acrobat isn't alone in this quest. No Hands Software's Common Ground and Faralon's Replica are also in the first wave of this emerging category. While it's still too early to tell which of these options makes the most sense for the bulk of applications, Adobe has an important secret ingredient—PostScript—that it leverages to make Acrobat both flexible and powerful (and somewhat expensive, too).

POSTSCRIPT AT HEART

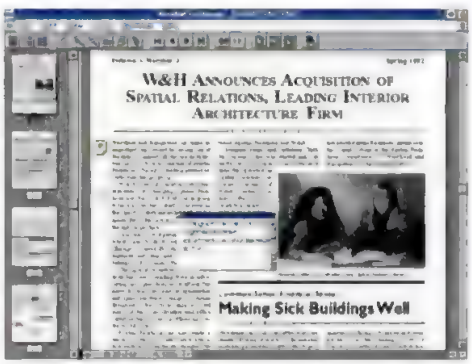
Acrobat converts documents to its PDF (Portable Document File) format, which implements a rigidly defined and compact variant of the PostScript Level 2 language. It lacks procedures, variables, and control constructs, replacing them with support for random access, hypertext links, and a vehicle for passing font information to the viewing system. Since PDF files are written in 7-bit ASCII, they're platform independent; since they're PostScript, they're resolution independent.

When viewing a PDF file with either Acrobat Exchange or Acrobat Reader (two of the Acrobat family of products), the software checks if the fonts in the document reside on the viewing PC. If they don't, the software chooses one of the two multiple master fonts that ship with Acrobat—a serif and a sans serif face—and uses font metrics to generate fonts that don't look quite like the originals but that take up the same space so that all lines break correctly. The spatial integrity of the text is maintained.

In contrast, Common Ground and Replica use the operating system imaging models on the authoring platform—QuickDraw and the Windows GDI—to describe documents, and both support read-only embedding of TrueType fonts to solve the font problem. Both render PostScript Type 1 fonts as bitmaps, optimized for 300-dot-per-inch resolution, so they can create documents that look identical to the originals.

The Adobe Acrobat product line comprises several Windows and Macintosh products. The $195 Acrobat Exchange lets you create, view, navigate, and print PDF files. It also lets you create thumbnails of pages, insert bookmarks, place notes on pages, and perform full-text searches.

To create a PDF file, you print a document from any application to a special printer driver called the PDF Writer, which converts Windows GDI or QuickDraw primitives into PDF descriptors.



NAVIGATE: *The thumbnail view in Acrobat Exchange and Reader help you get around.*

The $695 Acrobat Distiller and $50 Acrobat Reader, on the other hand, are single-function utilities. Distiller is a PostScript interpreter that takes any PostScript or EPS file, singly or in batch, and translates it to the PDF format. Reader is a runtime viewer that can be used for mass distribution. An Exchange Starter Kit lets developers integrate PDF support into their custom apps.

Adobe Acrobat Components

	Function	List price
Distiller	Converts any PostScript file to an Acrobat-readable PDF file	$695 (any single standalone platform), $2,495 (any single network platform; unlimited users)
Exchange	Lets you create PDF files via print driver (PDF Writer), as well as view, navigate, and print them	$195 (single system, Macintosh or Windows), $156 per user (up to 5 users, Macintosh or Windows), $150 per user (up to 25 users on any platform), $146 per user (up to 100 users on any platform)
Exchange Starter Kit	Consists of Distiller and Exchange	$1,395 (up to 10 users on any platform)
Reader	Lets you view, navigate, and print PDF files	$50 per user (up to 50 users on any platform), $40 per user (up to 100 users on any platform), $35 per user (up to 500 users on any platform)

SURPRISING SIMPLICITY

It's exceptionally easy to install, learn, and use Acrobat. From an end user's viewpoint, Exchange represents the most complex of the three mainstream products, but it remains an extremely simple application. For instance, to create a bookmark in a document, you go to the page on which you wish to attach it, select New Bookmark, and edit its name; you can also indent bookmarks to mimic the document's structure. To create a hypertext link between two pages, you go to the source page, select the Link tool from the toolbar, jump to the target page, and click again.

Those are the two most sophisticated operations Exchange performs. You can also zoom in or out, copy text to the clipboard (but not graphics), rotate, crop, and delete pages, and insert pages from other PDF files. While Exchange isn't meant to be a full-fledged hypertext authoring system, a few extra capabilities, such as the ability to create multiple links at once, might come in handy. Considering Acrobat's ostensible purpose—which is translating documents for *on-line* viewing—there's a glaring absence of typical display sizes in the PDF Writer setup; and while you can set up a custom page, you can't specify the size in pixels.

PostScript print files can be generated on any platform regardless of whether the Acrobat software yet exists for that operating system; thus, one of the primary benefits of

Continues on page 46

The **NEW** under $1000 TI microWriter PS23 is the best value in laser-quality PostScript printers.

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CIRCLE 139 ON READER SERVICE CARD

Acrobat

CONTINUED FROM PAGE 44

the Distiller over Exchange for PDF file creation is that you can use it to convert files generated on DOS and Unix systems, as well as convert files without having the originating application. (Adobe expects to ship DOS and Unix versions by the end of 1993.)

Keep in mind that you must have the fonts used by the original document on the Distiller system. For best results, you must also use the Distiller when generating PDF files from any document with an EPS graphic; the PDF Writer only includes the low-resolution bitmap representation embedded in the header of the EPS file. And Adobe recommends that you use Distiller for any application that generates complex graphics, such as CorelDRAW, Harvard Graphics, and Aldus PageMaker.

Adobe's solution turns out to be both better and worse than the competition's. Both Farallon and No Hands are positioning their products for the mainstream business user, claiming that Acrobat's resolution independence is important solely for hard copy output. But Common Ground (the Macintosh version we looked at) and Replica (a prerelease Windows version) both showed typographical artifacts (overlapping characters for kern pairs and poor character spacing) in close-up zooms that Acrobat handled with aplomb.

On the other hand, Acrobat doesn't let you embed TrueType fonts, and the multiple master fonts included with the software poorly represent unique and nonstandard typefaces. Furthermore, Adobe doesn't offer a free viewer, and its hardware requirements are pretty stiff for a potentially universal solution. The PDF files also tend to be large: Those resulting from our test files were about twice the size of the originals, although they were about half the size of corresponding standard PostScript files we generated. And screen display is slow.

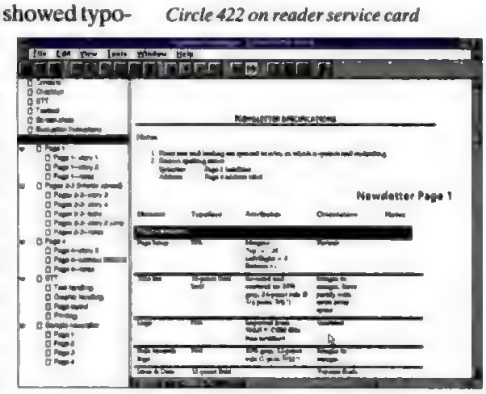
Adobe has formidable plans for Acrobat. By the end of this year, it intends to support cross-document searches (using the Verity search engine), and within the first half of 1994 proposes to incorporate the Avalanche SGML interpreter (for the creation of structured documents) and an OCR engine developed with OCR Systems. Ultimately, whether or not Adobe's solution matches your plans depends upon how heavily you weigh small, fast, and cheap against big, expensive, and powerful for the electronic distribution of documents.

• List price: *Adobe Acrobat, see chart.* Requires: *4MB RAM, 6MB hard disk space, Windows 3.1. Adobe Systems Inc., 1585 Charleston Rd., P.O. Box 7900, Mountain View, CA 94039; 800-272-3623, 415-961-4400; fax, 415-562-6775.*

Circle 422 on reader service card

FIRST LOOKS PLUS

From August 23 through August 27, you can go online to download a demo of Acrobat Reader or to discuss Acrobat with Lori Grunin, Adobe CEO John Warnock, Adobe president Charles Geschke, and product manager Rob Babcock. Type GO ZNT:EXEC from any CompuServe prompt.



HYPERTEXT: *Acrobat Exchange's hypertext abilities let you link any two pages.*

■ **Upgrades**

SLC/Now! Board Revivifies 286-Based PS/2 Systems

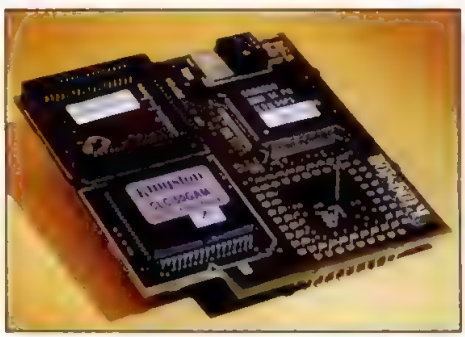
BY WINN L. ROSCH

Drop Kingston Technology's $425 SLC/Now! board into your 286-based PS/2 Model 50, 50Z, or 60, and you'll gain 50-MHz 486 power without losing IBM sanction. Although marketed exclusively by Kingston, the SLC/Now! was designed and manufactured by IBM Technology Products and is backed by IBM field service.

Once installed, you can see the performance of your aging system shoot up by more than a factor of ten on one PC Labs benchmark test (the prime number sieve component of the Processor Tests). On other measures, the improvement is more modest but definitely noticeable—enough to push up the Processor Harmonic benchmark score from 1025.09 to 2858.76 on a Model 60. Because the rest of your PS/2 is unchanged by the SLC/Now! upgrade, video performance and most memory and disk operations are essentially unaltered.

The brain behind the SLC/Now! is the IBM-manufactured 486SLC2 microprocessor, Intel-licensed and IBM-improved with an internal 16K cache. As with Intel's DX/2 series, the 486SLC2 doubles its 25-MHz clock to perform internal operations at 50 MHz. (For tighter budgets, Kingston also offers two SLC/Now! upgrades based on IBM's 386SLC chip: a 20-MHz version that lists for $129 and a 25-MHz version for $235.)

The SLC/Now! board itself measures 2.7 by 2.9 inches and is highly integrated. It holds only two major chips—the 486SLC2 and an IBM-made ASIC—along with a voltage regulator and a socket for a 25-MHz 387SX coprocessor. Installation simply requires prying your old 286 from your PS/2 and pressing the SLC/Now! board into its place.



NEW LIFE: *Turn your 286 into a 50-MHz 486.*

The sole cause for concern is aligning the poorly marked pin 1 of the upgrade board with pin 1 of your old 286's PGA (Pin-Grid Array) socket.

You'll want to be careful if you have to remove expansion boards to gain access to the socket. Put them back in slots other than their original ones, and you'll have to pull out your Reference Disk and reconfigure your system. Otherwise, the SLC/Now! requires no other setup, and your system will boot immediately using its new brain.

While the SLC/Now! will endow a vintage PS/2 with snappier performance and 386-specific software compatibility, the upgraded system won't rival a new 486. But it will breathe new life into those near-obsolete PS/2s.

List price: *SLC/Now!, 50-MHz 486SLC2, $425; 20-MHz 386SLC, $129; 25-MHz 386SLC, $235.* Requires: *Micro Channel-based IBM PS/2 (Model 50, 50Z, or 60). Kingston Technology Corp., 17600 Newhope St., Fountain Valley, CA 92708; 800-835-6575, 714-435-2600; fax, 714-435-2699.*

Circle 420 on reader service card

PCs

IBM Enters Direct Channel With New ValuePoint Line

BY TIN ALBANO

By revamping its recently introduced ValuePoint line of desktop computers, IBM has taken on direct-market vendors by offering value-oriented systems at midrange prices. The new ValuePoints are designed around newly developed ISA-based motherboards and are powered by Intel processors. There are three models to choose from: a standard desktop, a space-saving slimline unit, and a mini-tower.

The $3,339 ValuePoint 466DX2/T we tested came in a mini-tower case, with 4MB of RAM (expandable to 64MB) and a 527MB hard disk. This well designed unit makes the most of its relatively small 7.9- by 16.2- by 16.9-inch (HWD) size, offering eight ISA expansion slots, six drive bays, integrated local-bus video (with 1MB RAM of video memory), and a ZIF (Zero Insertion Force) socket for easy processor upgradability all the way up to future Intel OverDrive processors based on Pentium technology.

The 466DX2/T will certainly be capable of holding its own against other midpriced PC offerings from more established direct market vendors when it comes to performance. The highly upgradable system produced above-average scores on our benchmark tests when compared to the historical average of other 66-MHz 486DX2-based computers we've tested.

Processor, memory, and disk scores ranged from about 12 percent to 43 percent better than average. Especially notable, however, are the XGA video subsystem's Graphics Winmark result of 17.4 megapixels per second and a DOS Video score of 6.7 millions of operations per second.

It will be how well IBM provides its customers with service and support that will determine how competitive its ValuePoint line will be.

Unlike either IBM's higher-end PS/2s or its lower-end PS/1s, the ValuePoints are marketed directly, and IBM has set up a customer service and support program, HelpWare, that is part of the package. It includes 24-hour setup, usage, and service assistance (via phone, fax, or modem), one-year on-site service, and a 30-day money back guarantee.

PERFORMER: *IBM's ValuePoint had high scores.*

All of IBM's lines overlap slightly, but each has its place in the market (see the sidebar, "IBM PC Lines Address All Markets"). The PS/2 line typically represents the high end, where technical innovations tend to appear first. By comparison, the distinguishing factors between the PS/1 and the ValuePoint lines lie in the channels of sale, the quantity of preloaded software, and the degree of expandability. Both lines feature ISA-based machines with Intel processors, local-bus video, a choice of Windows 3.1 or OS/2 2.1, and slots for Intel P24T OverDrive upgrades.

The ValuePoints have some more advanced features than the PS/1s: video memory can be expanded from the standard IBM, which supports 256-color display in VGA mode, to 2MB, which allows for the same number of colors at 1,024-by-768 resolution; zero insertion force sockets allow for easier CPU upgrades, and up to eight slots and six drive bays provide room for expansion. Prices start at about $1,549 for a 486SX/25 with a 120MB hard disk, 4MB of RAM, a Super VGA monitor, and IBM's own PC DOS 5.02.

• List price: *IBM ValuePoint 466DX2/T with 4MB RAM, 527MB hard disk, IBM DOS 5.02, Windows 3.1; $3,399. IBM PC Co. Route 100, Somers, NY 10589; 800-426-2968, 914-765-1900; fax, 800-426-4329.*

Circle 426 on reader service card

IBM PC Lines Address All Markets

Three independently developed product lines in three distinct markets are IBM's ammunition in the battle for PC market share. Each line targets a different niche, from the PS/2's corporate power users to the PS/1's first-timers, with the PS/ValuePoint's direct-market buyers somewhere in the middle.

The PS/2 line is targeted at corporate users who seek a combination of power, technological innovation, green PCs, and high-end servers. These 32-bit Micro Channel Architecture systems offer a choice of IBM's 486SLC2 chips or 486-based Intel CPUs, and come with OS/2 2.1. Available through authorized dealers in addition to IBM's sales force, PS/2s start at less than $1,900 for the low-power PS/2E with a 486SLC2/50, 8MB of RAM, a PCMCIA slot, a 120MB hard disk, and IBM's XGA display, and can run as high as about $30,000 for a custom-designed server. PS/2s include a three-year warranty and 4-hour on-site service.

A finer line separates the PS/1s and PS/ValuePoints. The distinguishing factors lie in the channels of sale, quantity of preloaded software, and degree of expandability. Both lines feature ISA-based machines with Intel processors, local-bus video, a choice of Windows 3.1 or OS/2 2.1, and slots for Intel P24T OverDrive upgrades.

For home and small-business users, the plug-and-play PS/1s feature preinstalled software such as MS-DOS 6.0, Windows 3.1, Microsoft Works for Windows, and Broderbund's The New Print Shop, a host of IBM utilities, and modems. Available at mass-market stores such as Sears and Price Club, the systems start at about $1,000 for a 486SX/25 with an 85MB hard disk. Like the PS/ValuePoints, PS/1s include a one-year warranty and on-site service.

—Melissa J. Perenson

■ Mapping

MapMaker and Maps&Data: Two Natural Geographics

BY ROCK MILLER

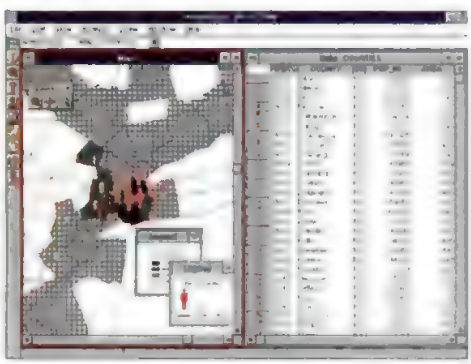
If you want your presentations to have a geographic dimension, the two leading vendors of mapping packages are angling for your business. Strategic Mapping, makers of DOS-based Atlas*GIS and Atlas Pro, has a new version of its Atlas MapMaker for Windows ($395), and MapInfo Corp. offers the new Maps&Data, (also $395), which repackages much of MapInfo for Windows in a trimmer form.

The best way to define these programs is to describe what they don't do. Though both can plot based on the center points of irregular map areas, neither can locate specific points by reference to a detailed street map. They can't answer a query to find the number of sales contacts within a 50-mile radius. Nor can they create and edit accurate boundary files for maps.

But don't think of them as "GIS Lite." In their field of expertise—thematic maps—these programs are more sophisticated than their high-end cousins. Each has a layered architecture to depict multiple variables on the same map. This lets you create complex maps composed of scalable symbols, pies, or bar-chart overlays with TrueType annotations. And each comes with libraries of maps and world demographic data.

A DESIGN CHOICE

For general usability, Maps&Data rates best. Its side-by-side map and data windows create a simple and understandable working surface, and its small toolbox brings a good selection of essential functions within easy reach. Creating geographic views, plotting points, attaching data columns, and creating map analyses is relatively quick and easy.



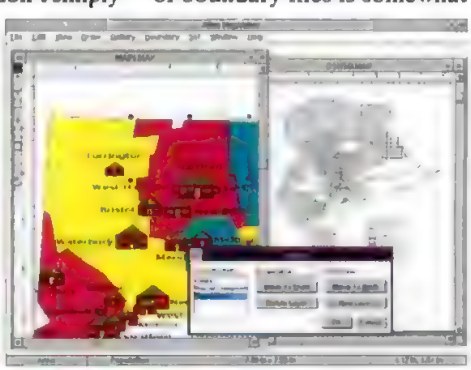
TWO WINDOWS: *Maps&Data's screen makes it easy to work with data and map views.*

MapMaker for Windows' interface is more confusing, requiring you to go through several steps to create a map, but it's also more flexible. Unlike Maps& Data, you don't simply select a map database and start to work (though you can shorten the process by calling up sample files). Instead, you must import individual boundary files to create a composite base map and then import data separately into the worksheet.

MapMaker's design does have the advantage of letting you work with a custom selection of maps. It's your only choice if your presentations require the use of your own maps, since it supports the various import, overlay, projection, and calibration options you need. Maps&Data isn't designed to import individual boundary files; instead, you must work with its built-in map databases, zooming into the areas in which you want to work.

Maps&Data has an edge when it comes to file handling. It uses .DBF as its native data file format, and it can easily import .WK1 or .XLS files, or a range of ASCII formats. It can also link to Excel or other Windows spreadsheets using DDE. Maps&Data can also sort and select data in typical database fashion, though unlike MapMaker it doesn't support data transformations. By contrast, MapMaker imports only ASCII, SYLK, .WK1, or Excel 2.1 files and has no DDE support.

While Maps&Data can export both finished maps (as metafiles or bitmaps) and selected data records (as .DBF files) directly, MapMaker can do this only by cutting and pasting through the clipboard. MapMaker's selection of boundary files is somewhat richer, but Maps&Data's selection of demographic data variables is a little better.



MULTILAYERED: *MapMaker can create maps composed of any number of layers.*

Both products have something to learn about presentations, but MapMaker needs to learn more. Maps&Data does have a significant flaw in its oddball page layout system. Instead of letting you lay out elements on a page image, it simply prints map elements (such as maps or legends) in relation to one another the way they appear on the screen—the printer driver automatically scales the windows to fit on the printed page. Though clever, this works poorly in practice: Without a page ruler to go by, it's hard to get things laid out properly.

MapMaker for Windows doesn't have this problem; in fact it works too much like a drawing program for its own good. Unlike a GIS package, MapMaker doesn't seem to maintain a fixed coordinate space. Though maps are imported initially with the proper alignments, once they have been resized and laid out on the page, they are treated as free-floating objects, and the system loses track of their global positioning.

Changing MapMaker's various attributes is a snap, but we experienced persistent formatting difficulties when resizing legends. In MapMaker, you can place annotations on any layer, but you can edit them only if that layer is the active one. By contrast, Maps&Data keeps all its user annotations on a separate drawing layer for easy access. Its symbol library and color handling are also far superior to MapMaker's.

• List Price: *Atlas MapMaker for Windows, Version 1.1, $395; upgrade, $49.95.* Requires: *2MB RAM, 3MB hard disk space, Microsoft Windows 3.0 or later. Strategic Mapping Inc., 3135 Kifer Rd., Santa Clara, CA 95051; 408-970-9600; fax, 408-970-9999.*

Circle 402 on reader service card

• List Price: *Maps&Data for Windows, $395.* Requires: *2MB RAM (4MB recommended), 10MB hard disk space, Microsoft Windows 3.0 or later. MapInfo Corp., 200 Broadway, Troy, NY 12180; 800-327-8627, 518-274-6000; fax, 518-274-6066.*

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38
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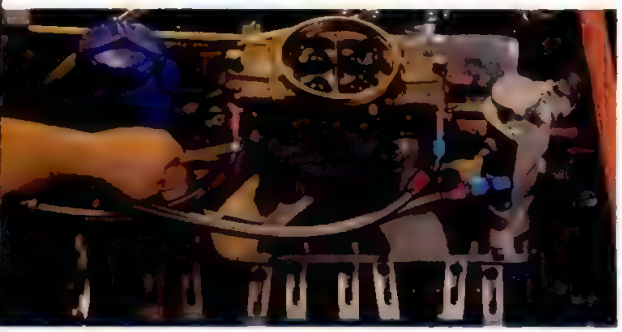

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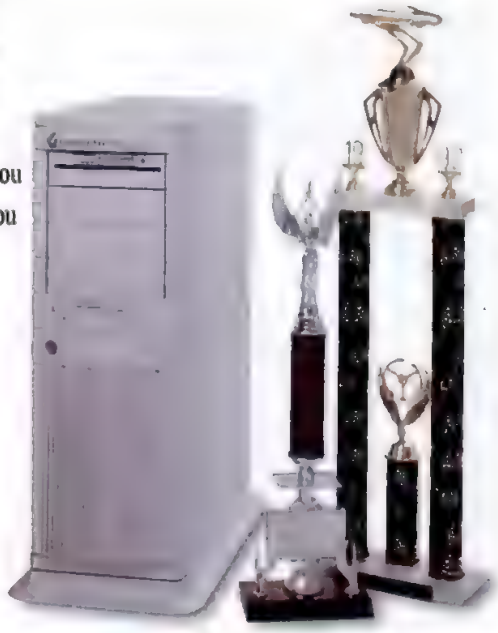

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Personal Information Management

ECCO: Your Life as an Outline

BY GREGG KEIZER

There's always one more way to skin a cat. Arabesque Software's ECCO Professional, a decidedly different personal information manager (PIM) for Microsoft Windows, takes an unusual approach to organizing the people, phone calls, appointments, meetings, and projects that crowd your days.

This $395 program doesn't use a form-based database and Day-Timer–style calendar, as most PIMs do. Instead, it is built around outlines and adds powerful cross-referencing tools that make it look almost spreadsheet-like. The result is an original PIM that may remind you of two earlier attempts at the same kind of thing: Lotus Agenda and Symantec GrandView. ECCO is overwhelming at first, but it can conform to the way you work.

The outline-like interface is crucial to ECCO's power. Each name, each phone call, and each meeting is an item in an outline. Because they're discrete objects, not simply fields in a database, you can organize them and rearrange them at will by clicking and dragging, just as you do within a word processor's outliner. And since ECCO organizes these items into folders, you can create cross-referencing connections between people and notes or meetings and projects just as easily. Drag a task's outline into multiple folders, perhaps those labeled with your staff members' names, and the information appears in each person's individual folder. Change the information in any folder, and it changes everywhere.

This outline structure is bolstered by the addition of columns, which makes ECCO look somewhat like a spreadsheet. In the phone book, for instance, you can easily create a column named Call Back, that when clicked enters a check mark. Since the column is itself a folder, you can review all your call-back obligations just by dragging the folder into an outline window. Even more flexible is ECCO's ability to build ad hoc outline views based on combinations of folders. Drag the Done folder to an open outline, for example, and all your completed tasks appear. Drag and drop the Cost Estimate folder onto a column, and all completed projects are accompanied by a dollar figure. No other PIM can match ECCO when it comes to flexibility.

FACT FILE

ECCO Professional, Version 1.0

Arabesque Software Inc., 2340 130th Ave. NE, Bellevue, WA 98005; 800-457-4243, 206-869-9600; fax, 206-885-0127

List price: $395 ($99 through September, 1993)

Requires: 2MB RAM (4MB recommended), 4MB hard disk space, Microsoft Windows 3.1

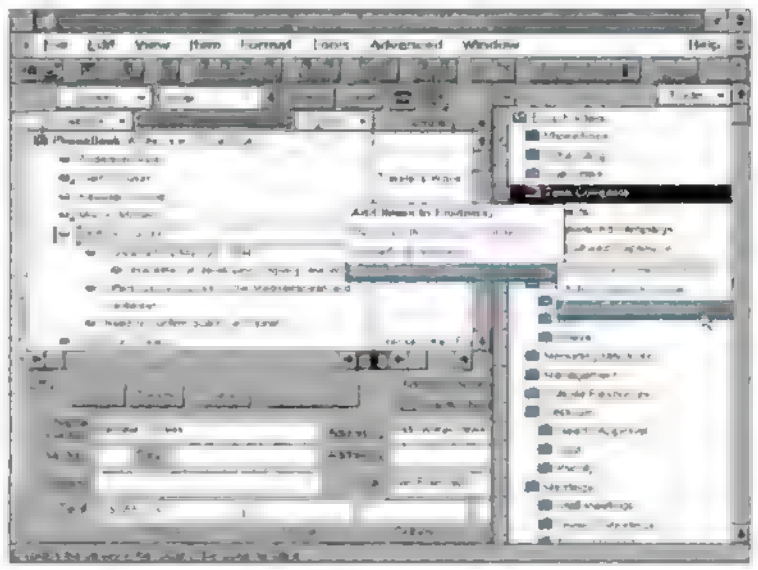
In short: ECCO is a one-of-a-kind PIM that relies on outline-style views, customizable columns, and organizing folders to display your day and data. It's the most flexible PIM on the market.

401 ON READER SERVICE CARD

BUT IS IT EASY?

Such cross-referencing and outline-building skills will come slowly at first, if only because both the concept and its ECCO implementation are foreign to PIMs. Arabesque was smart to include several templates with the package. These templates—specific to such areas as legal, research, project management, and time management—help you assimilate the program's features. Other aids include optional short-form menus that hide the program's advanced features, extensive on-line help, and ECCO's comprehensive documentation.

ECCO's calendar and phone book are immediately accessible, however. The phone book may show a form at the bottom of the screen, but it's actually an outline too. You can't add fields to that form, but you can add new columns to each name item to show such things as the last contact date or the result of the last phone call. The phone book dials numbers through a modem and times and logs calls. It also supports searches based on first name, last name, company name, or any of its standard columns.



OUTLINE VIEWS: *ECCO's outline-based design makes it eminently customizable.*

The calendar is even slicker. It shows appointments and meetings in a list-like format, marking allocated time with colored bars. You can peruse commitments in day, week, or month views, drag name items from the phone book to create call or contact ticklers, set both simple and complicated alarms, and mark to-do items as done. Since it's simply another outline, the calendar can be customized too; adding a name column designating who's handling what task takes just a few clicks of the mouse.

FIRST LOOKS PLUS

From August 30 through September 3, you can go on-line to discuss Ecco with Gregg Keizer and Arabesque Software founders Pete Polash and Bob Perez. Type GO ZNT:EXEC from any CompuServe prompt.

ECCO provides a slew of handy gadgets and high-powered features to oil the organizational tracks. Its Shooter, a one-step copy-and-paste tool, sends a selected item's text to other active Windows applications and documents and imports text directly into a variety of ECCO outline views. The toolbar is eminently customizable, and though group scheduling isn't implemented in this version, you can share outline views with others on the network. You can embed documents into an outline for fast retrieval, as well as launch applications directly from ECCO. Searches are fast, and a comprehensive filtering system with Boolean operators lets you selectively display information in any outline.

ECCO's flexibility is both its best and worst characteristic. Like Lotus's defunct Agenda, there's so much you can do with ECCO that it's easy to get lost in the choices, especially when they aren't evident. Even with the templates as a guide, expect a tough time digesting the program during your first few days. ECCO has a few minor but irksome glitches: a dialer that takes three keystrokes, no direct fax support, and the necessity of multiple mouse clicks for seemingly simple tasks.

Even so, ECCO's tough to pass up, especially at its introductory price of $99. This is a unique Windows application, one of the few PIMs that can truly mutate into a form that fits the way you work. □

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—*PC Magazine*, May 11, 1993

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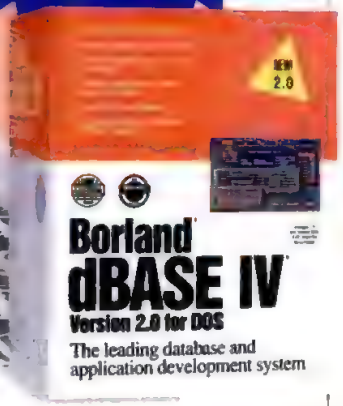

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*Usability Science Corporation, dBASE IV v2.0 vs. FoxPro v2.5, June 1993. †dBASE Compiler for DOS sold separately. Copyright © 1993 Borland International, Inc. All rights reserved. All Borland product names are trademarks of Borland International, Inc. Offer good in the United States and Canada only. Prices in U.S. dollars. Dealer prices may vary. BI 5750.1

CIRCLE 287 ON READER SERVICE CARD

■ **Wireless Networking**

RangeLAN: This Network is On the Air

BY OLIVER RIST

Tired of fumbling with Xircom adapters, tangled cables, and port replicators? If you've got a PCMCIA-capable notebook with a Type II slot, you can donate your cables to Goodwill's PC department. With Proxim's $595 RangeLAN, you can now hook into the world of wireless networking.

Of course, the usual unresolved issues remain: No health report has surfaced to prove that these radio emissions are safe, and there still isn't a definite standard, though the IEEE committee 802.11 is dedicated to the task. On the other hand, Proxim has done a great job of providing a peaceful way for wired LANs and wireless LANs to coexist.

Network managers may wince at the thought of implementing new technology on a delicately tweaked LAN. What's great about the RangeLAN is that you don't need to try anything new—Proxim's hardware comes with drivers that cooperate seamlessly with NetWare, NetWare Lite, LANtastic, LAN Manager, and Windows for Workgroups. And you don't have to worry about the line-of-sight headaches associated with infrared LANs.

Once we got the right drivers, installation of our RangeLAN was a snap. An ISA-based adapter was installed in an AST Bravo desktop host, which became our server. PCMCIA nodes were inserted into an AST PowerExec 4/25 Color Plus, an NEC UltraLite Versa, and a DECpc 425SL. Each notebook was equipped with Windows for Workgroups; and Proxim's driver software, including a pregenerated default IPX.COM file, was easily installed.

At that point we had a small but effective peer-to-peer LAN. Proxim, in fact, recommends this approach to businesses that move frequently, can't afford to rewire their office buildings, or have to connect remote workgroup locations. We went further by connecting to a full NetWare-based LAN. There were surprisingly few headaches. Once the ISA-card was installed in the server and the drivers were run, we had the choice of using new network IDs or logging on under our usual desktop names.

WIRELESS: *LAN link via PCMCIA.*

The RangeLAN nodes send and receive files and e-mail at the specified 246-kilobytes-per-second rate. You'll get a noticeable performance lag due to the differences in wired versus wireless data-throughput speed, but for small text files it's still reasonable. Range, on the other hand, was in dispute. In PC Labs we were able to get only about 100 feet away from the server before we lost the connection, but that might have been due to the high interference caused by close proximity to so many other systems. Proxim claims distances of 1,000 feet.

Proxim is also working on the $695 RangeLAN2/PCMCIA, which is expected to operate at distances of 300 to 500 feet in "normal office locations," and implements frequency-hopping spread-spectrum technology in the 2.4GHz band. Proxim claims this will allow the RangeLAN2 to deliver raw uncompressed data at 1.6 megabytes per second on ten independent channels.

If you need to hook into e-mail, network printing, or file sharing quickly, either RangeLAN solution is compelling.

• List price: *RangeLAN/ISA, $495; RangeLAN/PCMCIA, $595 per node; RangeLAN2/ISA, $595; RangeLAN2/PCMCIA, $695. Proxim Inc., 295 North Bernardo Ave., Mountain View, CA 94043; 415-960-1630; fax, 415-964-5181.*

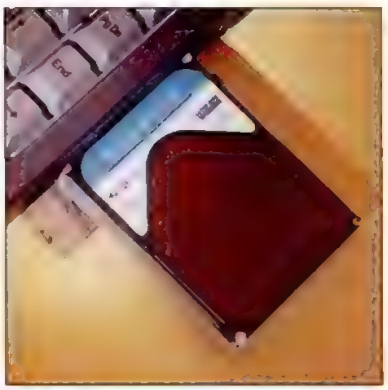
Circle 421 on reader service card

■ **PCMCIA Mass Storage**

Integral's PocketFile: 85MB in a Credit Card

BY OLIVER RIST

Integral Peripherals' two new PocketFile PCMCIA hard disks, a $495 42MB model and a $695 85MB model, conform to the latest PCMCIA 2.01 specification, with the 42MB version fitting into a standard Type III PCMCIA slot. The 85MB PocketFile requires a slightly larger slot that is currently available only in Toshiba notebooks. Both 5-volt drives contain a 32K buffer, and both have an 18-millisecond access time, a 35-ms maximum seek time, and a 1.5-second start time.



EASY FIT: *The convenience of PCMCIA.*

Integral is up front about which notebooks accommodate its drives. The PCMCIA driver is from System Soft, a PCMCIA BIOS and driver specialist. At the time we tested the PocketFile, the driver was guaranteed to work with the Toshiba T1900, T4500, T4500C, T4600, the NEC UltraLite Autograph, and the NEC UltraLite Versa.

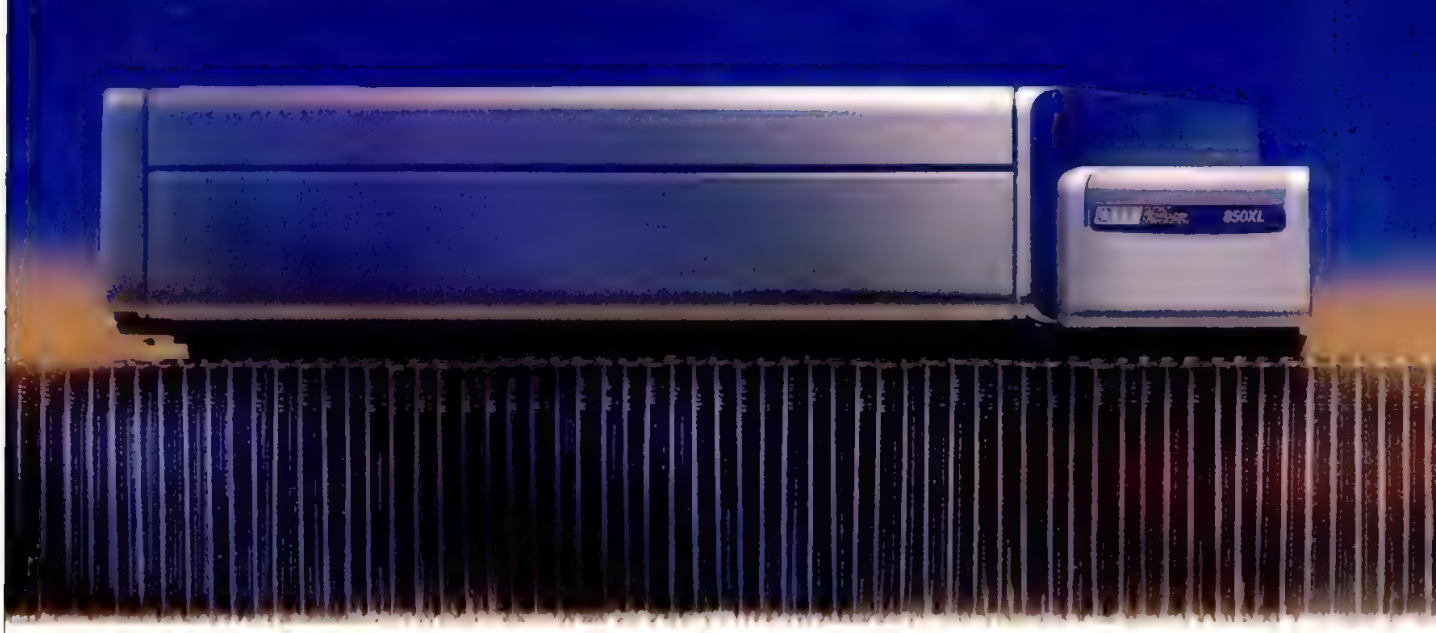
Some older PCMCIA notebooks have built-in BIOS compatibility with Integral's products (those whose BIOS was written by System Soft). These notebooks automatically recognize the drive. All you do is format and partition it. The driver also gives your notebook the ability to recognize other System Soft–compatible PCMCIA peripherals, including modems from AMT, AT&T, and Megahertz; LAN cards from IBM and Xircom; and flash memory cards from Epson, IBM, and Intel.

With a compatible machine, configuration is smooth. Install the right driver off the included floppy disk, plug in the PocketFile, reboot your PC, run the format utility, and that's it. The ATA portion (AT Attachment) of the PCMCIA spec lets your system look at the PocketFile as an IDE hard disk—drive D:.

PC Labs tested the PocketFile 42 in a Toshiba T4500C and found its performance well above average when compared to the hard disks in other 25-MHz 486SL-based notebooks.

• List price: *PocketFile 42, $495; PocketFile 85, $695.* Requires: *Notebook with PCMCIA, Version 2.01, and a Type III PCMCIA slot. Integral Peripherals Inc., 5775 Flatiron Pkwy., Boulder, CO, 80301; 303-449-8009; fax, 303-449-8089.*

Circle 425 on reader service card



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Video

Matrox MGA: The Fastest Windows Accelerators Around

BY JAMES KARNEY

Matrox Electronic Systems' MGA (Multimedia Graphics Adapter) series is the first of a new generation of 64-bit display adapters that offer PC users speed and high resolution rivaling that of dedicated graphics workstations.

But while Matrox's 11 adapters offer speeds 2 to 15 times faster than those of other Windows display solutions, there is more to MGA than just raw performance. The host of features and options for the boards includes a mouse port, laser printer acceleration, on-the-fly mode switching, virtual desktops, panning and zooming controls, anti-aliasing font technology, on-board VGA support, and hardware support for Microsoft Video for Windows. It seems the only extra the Matrox engineers left out was a seat belt.

Matrox's own 64-bit chip powers the VRAM-based cards, providing graphics acceleration at all pixel depths for Windows, OS/2, and CAD operations via custom drivers. In addition to the usual BitBlt (bit-block transfer), pattern, and fill acceleration, MGA boards have dedicated support for 3-D Gouraud shading, z-buffering, and character drawing.

Another performance edge is the exclusive use of VRAM 64-bit block write capability. MGA boards are the only PC adapters currently performing 64-bit operations.

MGA cards come in several configurations, with maximum resolution and price differences determined by the amount of memory included. You can get versions for ISA, VL-Bus, and Micro Channel interfaces now, and a PCI-based card should be on sale soon. Bargain-conscious power users may opt for the Ultima models, which start at $599.

STUNNING SPEED

We installed the 3MB MGA Impression ($1,299) on a 33-MHz 486 and ran PC Magazine Labs' Windows Benchmark Tests, Release 3.1. The results were spectacular, with the board yielding a Graphics Winmark score of 16.8 megapixels per second at 800-by-600 resolution with 256 colors, a less-than-optimal mode for this card. On a 66-MHz system, the board scored an astonishing 56.8 megapixels per second.

By comparison, in our last evaluation of video boards ("Waking Up Windows," April 13, 1993), the Mach-32–based ATI Graphics Ultra Pro VESA Local Bus scored 16.3 at this same resolution.

For some other real-world comparisons, we tested the VL-Bus version of the 3MB MGA Impression on a 66-MHz 486 DX2 machine, and also tried some sample vector and bit-mapped graphics files. The numbers were impressive at 1,024-by-768 resolution with 256 colors. Graphics Winmark scores ranged from 58.6 to 60.2 megapixels per second (and from 38.4 to 40.1 for the ISA version). Matrox claims the MGA will do even better on a Pentium PC and with a PCI local-bus interface.

Matrox MGA Boards

Model	RAM	Bus	Price
Ultima/1/A	1MB	ISA	$599
Ultima/2/A	2MB	ISA	$849
Ultima/2/V	2MB	VL	$899
Ultima/2/M	2MB	MCA	$999
Impression/3/A	3MB	ISA	$1,299
Impression/3/V	3MB	VL	$1,299
Impression/3/M	3MB	MCA	$1,499
Impression/3Z/A	5MB	ISA	$1,499
Impression/3Z/M	5MB	MCA	$1,699
Impression Pro/4/V	4.5MB	VL	$1,699
Impression Pro/4Z/V	8.5MB	VL	$1,999

The system displayed a complex CorelDRAW file in 13.6 seconds at 1,024-by-768 in 24-bit color, while the older Matrox Impression AT-s took 20.8 seconds. Redraws were crisp, and only complex blends slowed the system.

The MGA can incorporate on-the-fly color dithering with its Quality Color Dithering Process (QCDP). We found the color quality to be almost indistinguishable from true color. Gray-scale tones had a blue tint, but photographic images looked very good. Though QCDP slows performance, it was still impressive. It provides smooth color and performance that matches or exceeds that of accelerated cards running at normal 256-color modes.

SWITCHING REQUIRED

Installing the Matrox MGA display adapter is simple: Choose an interrupt and memory address by setting DIP switches, then place the card in a free slot and run the setup routine. Our ISA board ran with the default settings, but the VL-Bus unit required a change of address.

We also had to install some of the operating and diagnostic files manually. Matrox said it will soon have fully automated setups and that final drivers will be available before this review appears. There are plans to provide a video encoder daughterboard for the MGA by Fall Comdex that will let users send PC displays to a VCR.

Included with the MGA are Matrox PowerDrivers for Microsoft Windows 3.1, Microsoft Windows NT, and OS/2 2.1. Later this year, drivers will be available for Unix X-Windows and Silicon Graphics' Open GL under Windows.

FACT FILE

Matrox MGA

Matrox Electronic Systems Ltd., 1055 Saint Regis Blvd., Dorval, Quebec, Canada H9P 2T4; 800-361-1408, 514-685-2630; fax, 514-685-2853

List price: $599 to $1,999.

In short: The new generation of 64-bit video boards are the best performers yet. If you need the ultimate in Windows acceleration for high-end graphics work, you will find the solution in one of these 11 models

404 ON READER SERVICE CARD

Changing modes using the on-the-fly control panel did uncover a couple of minor flaws. You can shift between any supported modes by using either a hotkey combination or a control- panel application. We saw a ragged phantom mouse pointer when switching from 1,152-by- 882 with 256 colors to 1,024-by- 786 with 16.7 million colors. There were also some problems during 24-bit screen redraws with the hardware pan and zoom. The drivers seemed perfectly stable when we did not use the pan and zoom or hotkeys in very high resolutions or 24-bit mode.

ULTIMATE ACCELERATION

There will be competing 64-bit graphics adapters announced in the future, but for now the MGA is the fastest you can get. While its drivers may still need some work, there are price and performance combinations from Matrox available now to please almost any Windows power user. □

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February 23, 1993

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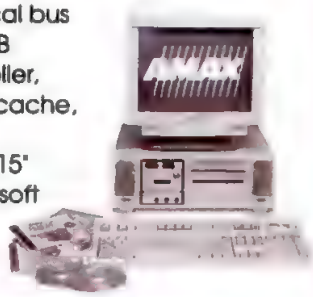

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Document Management

Watermark Inserts Scanned Images into OLE Apps

BY J.W. OLSEN

With the help of Microsoft Windows 3.1's Object Linking and Embedding (OLE) and your own scanner, Watermark Software's $149 Watermark Discovery Edition embeds an object representing virtually any document into OLE-client applications. Then you can browse, edit, or even fax the original document.

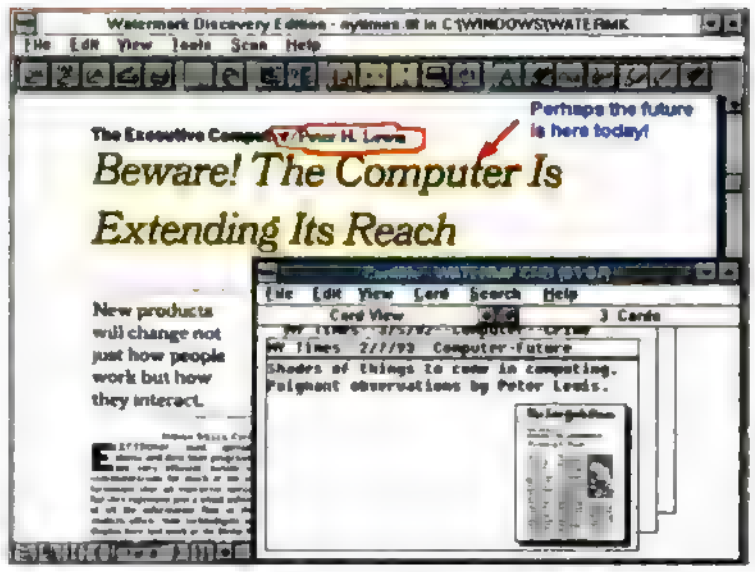
Here's an example. Suppose you have a file drawer bulging with contracts. After designing a database with Paradox for Windows or Microsoft FoxPro for Windows, you can use Watermark to scan the contracts into individual records. Need to send a contract to a client? Double-click on its object and use a Watermark highlighter to emphasize sections, a pen tool to delete words, and a text tool to add notes. Then use Watermark to embed the results in a letter or e-mail note or to fax the contract for client approval.

Watermark is reliable and effortless to learn and use, but its first-release status shows. We scanned two images during our tests. The thumbnail object it inserted into our database for one of images was a recognizable representation of the original; the other was a gray rectangle with no detail.

Watermark accepts input from scanners, fax software, and graphics files. Your scanner must be Twain compliant or have a Xionics Image Accelerator card. Otherwise, you're on your own to scan before invoking Watermark. Similarly, it directly supports only fax tools that output TIFF or multipage TIFF files, or are CAS compliant. Unsupported peripherals may require file conversion.

Watermark's native file format is one of the notorious non-standard TIFF variations. It failed to recognize a previously scanned TIFF file. The workaround the Import function yielded a useless image. Your best bet: Buy Watermark first, then supplement it with products if your needs include scanning or faxing.

Watermark is designed with networks in mind, and it even ships with optical character recognition software to shrink graphics files into manageable text files. Best of all, the program shrinks the clutter in your file cabinets while providing faster, more versatile control of their contents.



INSTANT ACCESS: *File, edit, and fax scans.*

• List Price: *Watermark Discovery Edition, $149.* Requires: *DOS 3.3 or later, Microsoft Windows 3.1, OLE-client compliant applications, 4MB RAM, 2MB hard disk space. Watermark Software, 129 Middlesex Turnpike, Burlington, MA 01803; 617-229-2600; fax, 617-229-2989.*

Circle 423 on reader service card

Presentation Graphics

At $79, Bravo! Slides In Under Competitors

BY STAN MIASTKOWSKI

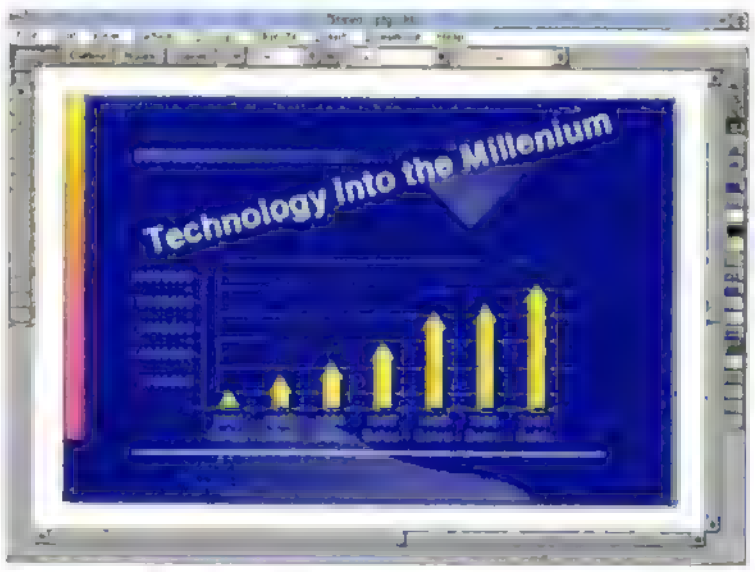
With a price of $79, Alpha Software Corp.'s new Bravo! presentation graphics package lowballs Aldus Persuasion, Harvard Graphics, Lotus Freelance Graphics, and Microsoft PowerPoint, whose street prices usually fall in the $300 to $350 range. A low price is always interesting, but Bravo! also delivers some ingenious new features.

Presentation packages usually make it relatively easy to toss together a basic set of slides. Bravo! is no exception. It's not quite as simple to use as, say, Freelance, which takes you by the hand and leads you through a step-by-step process. But you don't need to be a rocket scientist either. You choose a design from a menu of 26 choices, apply a template to each page depending on its content (title page or graph, for instance), and pop into an outline where you enter your text.

That outline mode is where Bravo! takes a slightly different tack from its competitors. Instead of entering text directly onto each page, you enter all text into the outline. To see what it looks like on the finished page, you have to click on the slide button, then back on the outline button to correct and continue. This switching back and forth is distracting, but at least it's quick.

If you like to tweak the look of your presentation, Bravo! gives you some great tools. Besides providing the usual selection of type styles and font sizes, Bravo! lets you anchor a text box at one end and rotate or stretch it around a point. You can even adjust kerning.

Other art-oriented features include Smart DataPictures, a selection of intelligent graphics and clip art with built-in intelligence. The images adjust themselves automatically as you use them. For example, when you use a pencil or an arrow graphic, stretching or expanding the image doesn't distort it.



POWERFUL PRESENTATIONS: *Despite Bravo!'s low price, it has some unique features.*

Chart and graph support in Bravo! are on a par with the competition. Create your own, import an existing spreadsheet, or set up a DDE or OLE link. Incorporating .WAV sound or .AVI video files into your presentation takes just a couple of mouse clicks. It even accepts Autodesk Animator Pro files. And Bravo! is currently the only presentation package with built-in support for importing files from Kodak Photo CDs.

The only shortcoming we could find is that the selection of predesigned slide formats is meager. But if all you want to do is create basic presentations, Bravo!'s $79 price is an unbeatable value. And if you want to get creative, Bravo! won't disappoint.

• List price: *Bravo!, Version 1.0, $79.* Requires: *2MB RAM, 3MB hard disk space, Microsoft* Windows 3.0 or later. Alpha Software Corp., 168 Middlesex Turnpike, Burlington, MA 01803; 800-451-1018, 617-229-2924; fax, 617-272-4876.

Circle 424 on reader service card

Not just a new Sound Blaster. A new 16-bit audio standard.

Introducing the Sound Blaster™ 16 Digital Audio Platform. A new concept in sound cards. And a new standard for 16-bit PC audio.

The new 16-bit PC audio standard: Includes programmable mixer, microphone, VoiceAssist speech recognition software, plus more than $1000 in software applications.

YOU WON'T BELIEVE YOUR EARS.

PC audio never sounded so good—genuine CD-quality audio with fully 12% more dynamic response and 15% better signal-to-noise ratio than any competing 16-bit sound board. Plus software data compression that delivers 16-bit fidelity while maximizing disk storage capacity.

Hands-free voice control.

But there's more. Included in the Sound Blaster 16 package is the biggest advancement in PC control since the invention of the mouse: our exclusive VoiceAssist™ software. It's a sophisticated speech recognition interface that uses a 32,000-command library to control Windows applications *hands-free!*

THE ONLY SOUND CARD THAT GROWS WITH YOU.

Unlike other 16-bit cards, Sound Blaster 16 comes with built-in interfaces for CD-ROM, MPU-401 MIDI and joystick control. And the unique modular, scalable architecture lets you add more advanced features and technologies *as you need them.*

FEATURES

State-of-the-Art PC Sound *with 16-bit Codec digital audio chip*

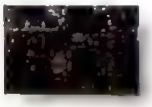
16-bit Data Compression *saves disk space without loss of signal quality*

Upgradable, Modular Platform *makes it easy to add new technologies like Advanced Signal Processing and Wave Blaster.*

100% Compatibility *with all Sound Blaster applications, plus cross platform support for Windows 3.1, DOS or OS/2.*

Upgrade to Advanced Signal Processing with one chip.

Like our Advanced Signal Processing chip that delivers 4:1 real-time hardware data compression while reducing CPU time up to 65%. Or professional-quality sampled wave synthesis with our plug-in Wave Blaster™ daughter board.



Upgrading is as simple as plugging in a daughter board.

And—unlike other cards—the Sound Blaster 16 is 100% *compatible with every game and application ever written for the Sound Blaster*...which is to say virtually every game and application available for sound.

NOBODY PACKS IN MORE VALUE THAN THE INDUSTRY LEADER.

And as if that weren't enough, we've completed the package with more than $1000 worth of leading software—not too shabby considering the entire package retails for just $249.*

So let's face it. When it comes to audio quality, features, and bottom-line value, we've got it all right here. With the Sound Blaster 16—the new 16-bit PC audio standard.

For more information about Creative Labs products and the name of your nearest Sound Blaster Dealer, call 1-800-998-5227.

Sound BLASTER™ CREATIVE™
CREATIVE LABS, INC.

*Base SRP.

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International inquiries: Creative Technology Ltd., Singapore. TEL 65-773-0233 FAX 65-773-0353.

CIRCLE 088 ON READER SERVICE CARD

The best reasons in the world to choose Primavera software.

Melbourne Cricket Ground, Australia

The new 47,000 seat Great Southern Stand replaces the smaller original built in 1937. Finest Hour® helped schedule and coordinate the project's extensive concrete work.

U.S. Embassy, Bolivia

Primavera software is being used to control the construction of the new $30 million U.S. Embassy in La Paz.

Remote Sensing Satellite, Canada

RADARSAT is a low orbit satellite that will take radar images of the earth. The engineering, design and manufacturing stages for this $300 million project are being scheduled using Primavera Project Planner® (P3®).

The Autobahn, Germany

P3 will be used to rebuild the Autobahn in what was formerly East Germany. Both contractors and subcontractors are standardizing on Primavera for this project

New Hong Kong Airport, Hong Kong

This $20 billion airport construction project also includes the construction of highways, an airport rail system, a suspension bridge and a cable stay bridge. Projected completion is June 1997.

Kuala Lumpur Tower, Malaysia

This $100 million, 420-meter tower will be the third tallest communication tower in the world. Estimated completion date is 1996.

The Georgia Dome, USA

The new $210 million structure features the world's largest cable-supported dome. P3 and Expedition® were used for scheduling and control.

Think about project management, and one name comes to mind. Primavera.

It's the software that people who run projects have come to rely on.

Call 1-800-423-0245 for a Free Preview Disk that shows what Primavera Project Planner can do for your projects. Or ask for a personal demonstration of Primavera capabilities in scheduling, resource management, cost control, performance measurement, contract control, communication and risk analysis.

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CIRCLE 148 ON READER SERVICE CARD

New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Brad Grimes

NEW

E-Mail Releases Are Here

Lotus Development Corp.'s cc:Mail for Windows, Release 2.0, has new rules and search capabilities, a redesigned interface, a spell-checker, and folders for drafts and trash. In conjunction with RAM Mobile Data and Intel Corp., Lotus has announced the cc:Mail Wireless Pack for use with cc:Mail Remote for DOS and cc:Mail Mobile for the HP 100LX palmtop. The Pack comes with an Intel Wireless Modem and will be sold directly through Intel (800-538-3373).

The pioneer of rules-based e-mail, **Beyond Inc.**, has announced Release 2.0 of its DOS and Windows BeyondMail products, featuring NetWare Global MHS support and prepackaged workflow applications. With the new Serial Routing Slip, which lets you track a message through BeyondMail 2.0, and Watermark Software's Explorer Edition, an OLE-based document imaging package, your workgroup can share and annotate thumbnail images in BeyondMail for Windows.

Futurus Corp. has announced a low-cost ($39.95 for one user) e-mail/phone-messaging product called Futurus Mail Plus, which has basic e-mail features, as well as MHS compatibilty, phone messaging, and a real-time chat feature. It's fully upgradable to Futurus Team, the company's workgroup scheduling product.

Meanwhile, **InterActive** has released M-Mail, Version 3.0, the vendor's multimedia e-mail system with automatic color conversion (for instances when you send a 256-color image to a PC that only supports 16), message forwarding with annotation, and OLE support.

• List price: *cc:Mail for Windows, Release 2.0, $495 for one platform pack; cc:Mail Wireless Pack, $775. Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142; 800-448-2500, 617-577-8500. BeyondMail, Release 2.0, $995 for 10 users. Beyond Inc., 38 Sidney St,, Cambridge, MA 02139; 800-845-8511, 617-621-0095. Futurus Mail Plus, $149.95 for five users. Futurus Corp., 211 Perimeter Center Pkwy., #910, Atlanta, GA 30346; 800-327-8296, 404-392-7979. M-Mail, Version 3.0, $89 per user (discounts for 100 users or more). InterActive Inc., 204 N. Main, Humbolt, SD 57035; 800-292-2112, 605-363-5117.*

Circle 406 on reader service card

HOT PROSPECT

New Harvard for Windows: Easier to Use, Easier to Share

Software Publishing Corp. (SPC) has enhanced its presentation graphics software, Harvard Graphics Version 2.0 for Windows. With Harvard Graphics' Desktop Conferencing feature, you can display your presentation on up to 64 networked PCs simultaneously during a conference call. You can use the new Chalk tool to highlight parts of the presentation, and then pass control on to another attendee who can continue the presentation. An electronic messaging feature lets attendees send messages without disturbing the conference call.

SPC has added the 5-Minute Coach, an on-line interactive tutorial, as well as a feature called The Advisor, which gives advice on performing tasks from directly within the Slide Editor view. Quick Looks have been added to dialog boxes and data forms throughout the product to give you chart miniatures and other visual hints so you can complete your tasks in fewer steps.

The new Harvard Graphics for Windows also supports multimedia, so you can add sound and video files to your presentations. The new version is scheduled to ship in September.

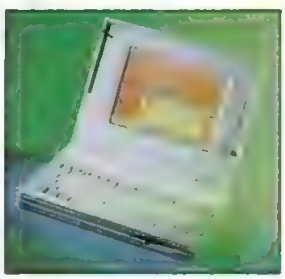
• List price: *Harvard Graphics Version 2.0 for Windows, $495. Software Publishing Corp., P.O. Box 54983, 3165 Kifer Rd., Santa Clara, CA 95056-0983; 800-624-6772, 408-988-7518; fax, 408-450-7915.*

Circle 405 on reader service card

NEW

Compaq's Fastest Notebook Is The New LTE Lite 4/33C

In its recent product announcement onslaught, **Compaq Computer Corp.** has raised the performance ceiling on its line of notebook PCs. The new 6.5-pound Compaq LTE Lite 4/33C is driven by the power-saving Intel 33-MHz 486SL processor and a standard 4MB of RAM. It has an 8.4-inch active-matrix display and comes with either a 120MB or 209MB hard disk and MS-DOS 6.0. The 4/33C also features Compaq's EasyPoint Trackball, which is integrated on the display panel, and a nickel hydride battery that is rated by Compaq to last between 2 and 3 hours.



Top of the line: The new Compaq LTE Lite 4/33C

• List price: *Compaq LTE Lite 4/33C, $4,698. Compaq Computer Corp., P.O. Box 692000, Houston, TX 77269-2000; 800-345-1518, 713-370-0670; fax, 713-378-1443.*

Circle 407 on reader service card

NEW

XyWrite Enters Windows Word Processing Fray with DOS Roots

It's not easy to port a DOS program to the Windows environment. Just ask WordPerfect or Lotus. But that's what **The Technology Group** is doing with XyWrite, the DOS-based word processor that's been widely embraced by editors and professional writers. XyWrite for Windows combines Windows capabilities with the power and efficiency of a command line interface. Thus, in addition to using the familiar button bars and rulers of Windows word processors, you'll be able to type commands such as SA to save documents or ST to store them.

Productivity tools in XyWrite for Windows include an Auto Replace feature that lets you create a glossary of shorthand notations so that

Photography by Thom O'Connor

when you enter the abbreviated text, the program automatically expands notations to complete words. A feature called Named Log and Resume lets you create multiple notebooks for holding different work projects, and XyWrite's Styles feature keeps uniform formatting across large projects.

• List price: *XyWrite for Windows, $495. The Technology Group, 36 S. Charles St., #2200, Baltimore, MD 21201; 410-576-1990; fax, 410-576-1968.*
Circle 408 on reader service card

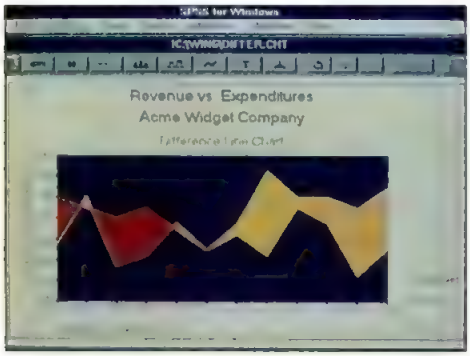
IMPROVED

SPSS Is Quick to Upgrade Windows Stats Program

While many statistical software vendors are struggling to release a Windows version of their products, **SPSS** is shipping an upgrade to its own pioneering statistical analysis package and four new add-on modules. SPSS Version 6.0 for Windows includes twice as many chart types as before and over 50 new statistical functions. The new SPSS for Windows also makes use of Microsoft's Open Database Connectivity (ODBC) standard so you can access data from a variety of databases or other applications, and it supports Microsoft's Messaging Application Interface (MAPI), which enables you to e-mail documents such as chart files.

The four new modules for the SPSS statistical analysis package are SPSS Trends, for forecasting and time-series analysis; SPSS CHAID, for identifying predictors and relationships between variables; MapInfo, for creating maps that display data about geographic regions; and QI Analyst, for statistical process control charting and reporting.

• List price: *SPSS Version 6.0 for Windows, $695 ($199 upgrade). SPSS Inc., 444 N. Michigan Ave., Chicago, IL 60611-3962; 800-543-2185, 312-329-2400; fax, 312-329-3668.*
Circle 409 on reader service card



Back already? The new SPSS for Windows has a wealth of new chart types.

BRIEFS

PCs

Ares Microdevelopment's low-cost Ascension series now features zero insertion force sockets for Intel's P24T processor and 128K of RAM cache. The Ascension 486-66DX2 VLB ($1,995) comes with 4MB of RAM, a 170MB hard disk, and a Diamond SpeedStar Pro VLB card. 800-322-3200, 313-473-0808.

Dell Computer Corp. has announced a series of energy efficient PCs in support of the EPA's Energy Star program. Each Energy Star Dell consumes less than 30 watts of electricity. The entry-level Energy Star is the 425s/L ($1,270) which comes with 4MB of RAM and a 120MB hard disk. 800-289-3355, 512-338-4400.

Epson America is shipping the Progression 4 line of PCs, which utilize Chips & Technologies' Wingine local-bus graphics acceleration. Prices start at $1,339 for systems that include 33-MHz 486SX, 50-MHz 486DX, and 66-MHZ 486DX2 models, with 4MB of RAM, 120MB hard disks, and 1MB of video RAM. Epson also announced the Progression NX series ($3,700), which is designed for developers in the NeXTStep for Intel environment. 800-289-3776, 310-782-5161.

INEX Technologies has unveiled the INEX 4000 series of notebook PCs (priced at $2,199 to $4,250) with an AudioDrive multimedia chip and built-in microphone and speaker. These PCs give you the ability to use voice in your applications. The INEX 4000 series has user-upgradable CPUs, hard disks, and displays. The units in the line also feature a built-in trackball. 800-783-4639, 408-986-9941.

National MicroComputers is shipping the Pro-System line of low-cost, 486-based systems ($1,850 to $2,250), which is highlighted by a video adapter that sports 2MB of RAM and an S3 805 accelerator chip. The Pro-System line also supports future P24T processors, has a 32-bit local-bus hard drive controller, and comes with a 245MB hard disk and 15-inch monitor. 801-265-3700

IMPROVED

Six Months Later, Lotus Upgrades Improv for Windows

Having shipped Improv for Windows Release 2.0 in February to wide acclaim, **Lotus Development Corp.** has quickly added features to draw more users to Release 2.1. One interesting enhancement is the inclusion of Q+E Extend for Improv Starter Edition, licensed from Q+E Software. This important addition lets you query data from a variety of external databases and pull that data into Improv. You get access to five database drivers: Btrieve, dBASE, Excel, Paradox, and Text. You can upgrade to Q+E Extend for Improv Client/Server Edition (with access to more than 20 database formats) for $99 through Q+E (800-876-3101).

Also new to Release 2.1 are Application Field Exchange (AFE), a workgroup-enabling feature linking you to Lotus Notes; and a network-ready installation procedure that makes it easier to install Improv on a network.

• List price: *Lotus Improv for Windows, Release 2.1, $495 (Companion Upgrade Edition, $199). Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142; 800-343-5414, 617-577-8500; fax, 800-693-3899.*
Circle 410 on reader service card

NEW

Get Rid of Your Business Card Collection with Scan-in-Dex

With **Microtek Lab**'s new Scan-in-Dex system, you can take those business cards you collect every day and scan the information directly into your personal information manager (PIM). The Scan-in-Dex creates 400-dot-per-inch black-and-white images of business cards and then converts the data into fielded text that can be imported into applications such as ACT!, Lotus Organizer, and PackRat. If you don't have a PIM, the Scan-in-Dex software also acts as a minidatabase and lets you decide if you want to store the business card information as a scanned image or as converted text. The scanner itself is compact (though not compact enough to be a notebook companion), measuring 2.1 by 6.65 by 6 inches (HWD) and weighing 1.65 pounds. Unfortunately, it also requires one expansion slot rather than attaching to a serial or parallel port.

• List price: *Microtek Scan-in-Dex, $399. Microtek Lab Inc., 680 Knox St., Torrance, CA 90502; 213-321-2121; fax, 310-538-1193.*
Circle 411 on reader service card

Read Them And Reap.

One of the top performers in its class, the Diamond Pro 17 is a very good value.

Windows Sources
February 1993

The Diamond Pro 17 is packed with well-planned technology. It is one of the best choices you make for a 17-inch Windows Workstation.

PC Sources
October 1992

Diamond Pro® 17 Color Monitor

3 YEAR WARRANTY
Parts and labor. Protected investment with guaranteed lower cost of ownership.
3

A high resolution 17-inch color monitor beats the cramped 14-inch variety for running Windows, and Mitsubishi's Diamond Pro 17 is a truly exceptional one.

PC Computing
September 1992

The Diamond Pro 17 has more going for it than just a large display. It's built around an intelligent microprocessor that lets it adapt to input from almost any computer video source. Overall, this monitor is an excellent choice for desktop publishing.

WordPerfect For Windows
February 1993

For more information or complete reviews call 1-800-843-2515, or write to Mitsubishi Electronics America, Inc., Display Products, 5665 Plaza Drive, P.O. Box 6007, Cypress, CA 90630. In Canada write Mitsubishi Electric Sales Canada, Inc., 4299 14th Avenue, Markham, Ontario L3R 0J2.

MITSUBISHI
DISPLAY PRODUCTS

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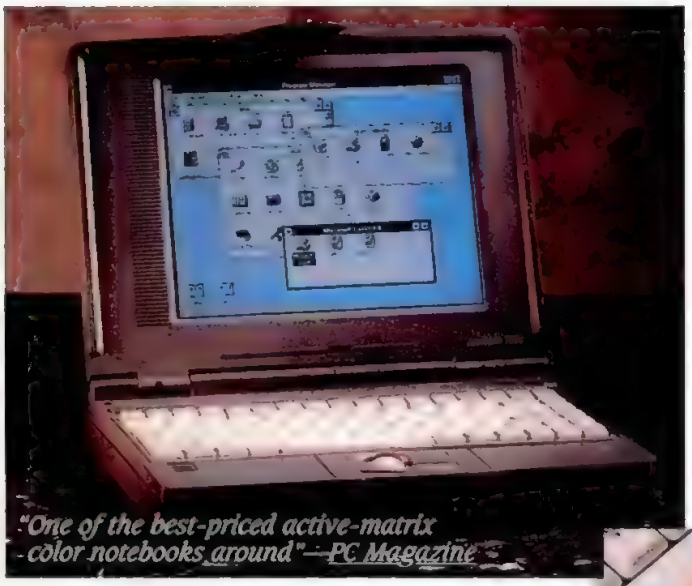
CIRCLE 280 ON READER SERVICE CARD

THE NEW COLOR NOTEBOOK



"One of the best-priced active-matrix color notebooks around"—PC Magazine

AcerNote 750c
Active-matrix Color with PCMCIA

- i486SL/25MHz
- 4MB System RAM
- One PCMCIA Type III Slot
- Accepts Two Type II Devices
- 120MB IDE Hard Drive
- Palmrest/Integrated Trackball
- 9.5" Active-matrix TFT Color Display
- SmartCase Modular Housing
- Pre-loaded MS-DOS 6.0/Windows™ 3.1
- MS-Works™/MS-Productivity Pack™
- PCMCIA Drivers

$3699

If you're chasing power, speed and state-of-the-art notebook color technology, get ready to pounce on the new AcerNote 750c. Just one in a series of modular notebook computers from Acer, the AcerNote 750c is packed with outstanding features to give you the best that mobile computing has to offer.

ACTIVE-MATRIX COLOR AND PCMCIA— THE LATEST NOTEBOOK TECHNOLOGIES

With the AcerNote 750c you benefit from a high performance 486 CPU and a big 9.5" active-matrix TFT color display with 256 brilliant colors in 640 x 480 resolution. One PCMCIA Type III slot which accepts two Type II devices gives you the most flexible and easy-to-use peripheral expansion capabilities available today. Just plug in a credit card-sized PC card and you can fax data, tap into your network or access a CD-ROM player.

INTEGRATED TRACKBALL FOR EASE OF USE

Every AcerNote computer includes innovative features such as SmartCase™ housing for unprecedented flexibility when configuring and upgrading, and an ergonomically designed palmrest and integrated trackball to reduce repetitive motion injuries during long periods of typing.

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All other brands and product names are trademarks or registered trademarks of their respective companies. ©1993 Acer America Corporation

THAT DOMINATES THE FIELD.

AcerNote 750
Non-glare Monochrome with PCMCIA

- i486SL/25MHz
- 4MB System RAM
- One PCMCIA Type III Slot
- Accepts Two Type II Devices
- 120MB IDE Hard Drive
- Palmrest/Integrated Trackball
- 9.5" None-glare Back-lit Display
- SmartCase Modular Housing
- Pre-loaded MS-DOS 6.0/Windows 3.1
- MS-Works/MS-Productivity Pack
- PCMCIA Drivers

$2149

AcerNote 730c
Dual-scan Passive-matrix Color

- SL Enhanced 486SX/25MHz
- 4MB System RAM
- 120MB IDE Hard Drive
- Palmrest/Integrated Trackball
- 9.5" Color LCD
- Internal Fax Modem
- SmartCase Modular Housing
- Pre-loaded MS-DOS 6.0/Windows 3.1
- MS-Works/MS-Productivity Pack
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intel inside

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The AcerNote series of notebook computers is just part of a complete line of products available from Acer. From the affordable Acer ACROS desktops to true multimedia workstations and high-performance servers, we have products to meet all your corporate computing needs.

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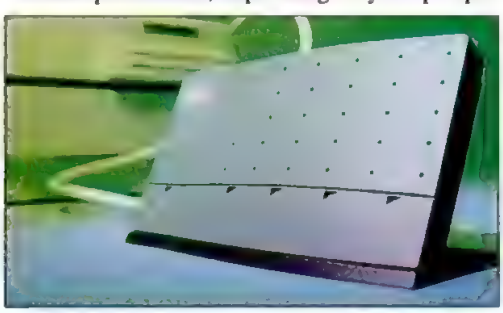
CIRCLE 034 ON READER SERVICE CARD

NEW

FarPoint Lets You Connect Four Peripherals to a Parallel Port

FarPoint Communications is injecting more life into high-speed, bidirectional parallel ports with a multiple-port extension that works with IEEE 1284-compliant Extended Capabilities Ports (ECP), Enhanced Parallel Ports (EPP), and IBM ExpressPrint ports. The F/MUX multiplexor lets you connect up to four peripherals to a single parallel port using 1284 Type C cables. (Type C cables have a 36-pin connector and clip latches). It's capable of sustaining a data-transfer rate of 2MB per second, depending on your peripheral's port, and it can connect printers or mass storage devices to your PC from up to 30 feet away. (FarPoint offers its own 1284 Type C cables, called FP/1284.)



Don't let its size deceive you. The F/MUX can connect to up to four peripherals.

Measuring just 4 by 6 inches standing, the F/MUX could be a perfect notebook PC companion, with front panel LEDs that light up to confirm that the port is in use. The F/MUX is scheduled to ship in early September.

• List price: *F/MUX, $399. FarPoint Communications, 104 East Ave. K-4, Suite F, Lancaster, CA 93535; 805-726-4420; fax, 805-726-4438.*
Circle 412 on reader service card

NEW

Scitor Breaks New Ground in Windows Project Management

Scitor Corp. knows that good things come to those who wait. Project Scheduler 6 for Windows, the company's first Windows effort, breaks interesting new ground. Among its unique features is the Advanced Resource Tracking Spreadsheet (ARTS), which uses a spreadsheet metaphor to let you enter and evaluate resource costs and usage on a period-by-period basis. Its most powerful feature may be its ODBC-based Project Repository, which lets anyone running a Microsoft "open" database application access project information.

Project Scheduler 6 for Windows also has an object-oriented report writer that enables you to make your reports look however you want, and an unlimited undo/redo feature that comes in handy if you want to do "what-if" analysis. Some of Project Scheduler 6's best project management features are its true overtime modeling and its ability to integrate multiple projects while maintaining cross-project links.

• List price: *Project Scheduler 6 for Windows, $695. Scitor Corp., 393 Vintage Park Dr., #140, Foster City, CA 94404; 415-570-7700; fax, 415-570-7807.*
Circle 413 on reader service card

BRIEFS

PCs

Samsung Electronics is entering the direct marketing channel with its new ValuePlus+ line of PCs. The SD933V ($1,699) and SD966V ($2,199) represent the high end of the line, with Intel 486 processors and VESA local bus; the SD760V ($1,099) is a low-cost desktop unit with a Cyrix 25-MHz 486SLC processor and 2MB of RAM; and the S3800V Notebook ($1,499) weighs 5.9 pounds and comes with 2MB of RAM, a 120MB hard disk, and a 10-inch backlit display. 800-724-6638, 201-229-4000.

SOFTWARE UPGRADES

Banner Blue Software is shipping Version 2.0 of its organization chart software, Org Plus for Windows ($199.99), which now fully supports OLE, supports even more graphics formats, and uses a proprietary file format for sharing charts across platforms. 510-794-6850

Version 1.2 of **Broderbund Software**'s Print Shop Deluxe ($79.95) is faster than before; it imports EPS, .PCX, and TIFF file formats; it lets you preview fonts and text on-screen; and it now prints foreign-language calendars. 800-423-9999.

A favorite shareware add-in for Word for Windows, **Guy Gallo**'s gToolBox, is now in Version 2.0b. Improvements have been made to such macros as ChooseDirectory and PrintOddEven, and new macros include BackupThisDoc and SnapShot. The latter takes a picture of the template's menu, key, and toolbar customizations. gToolBox is on CompuServe and BIX, and can be registered with the Advanced Support Group (800-788-0787) for $49.95. Registered users will now get a printed manual, a Windows installation program, and full source code.

Magee Enterprises' 10-year-old DOS utility, Automenu, has received another face-lift. Version 5.0 of the DOS-based menuing and program-launching product ($69.95) has a software detection module in its install program that locates software and creates menu items for each program. The user-interface has been enhanced to

IMPROVED

CA-Cricket Presents: New Features, Old Price

Computer Associates International will offer its enhanced CA-Cricket Presents, Version 1.5, for $92 through September 30 (upgrades cost $44.95). The new version of this Windows-based presentation graphics package comes with a runtime copy of Video Presents, called CA-Cricket Player, for displaying presentations on systems that aren't running CA-Cricket Presents. CA-Cricket Presents 1.5 is compatible with ATM Type 1, Bitstream Facelift, and TrueType fonts, and supports .BMP, JPEG, and Targa bitmapped images (plus a slew of other image formats) in both Windows and OS/2 file formats. Also included is the Clip-Art Connection, which gives you modem access to a library of over 29,000 downloadable clip-art images—over 100 of which are free.

• List price: *CA-Cricket Presents, Version 1.5, $199 ($92 until Sept. 30). Computer Associates International Inc., One Computer Associates Plaza, Islandia, NY 11788-7000; 800-225-5224, 516-342-5224; fax, 516-342-5329.*
Circle 414 on reader service card

NEW

A Z-Note By Any Other Name Is Still From Zenith Data Systems

Except for three more letters in the name and a detachable, pen-ready display, **Zenith Data Systems**' Z-Notepad 425Ln is almost identical to the company's Z-Note 425Ln notebook PC. It still features built-in Ethernet connectivity, an upgradable floppy disk drive and hard disk, and a flash BIOS, but now the standard

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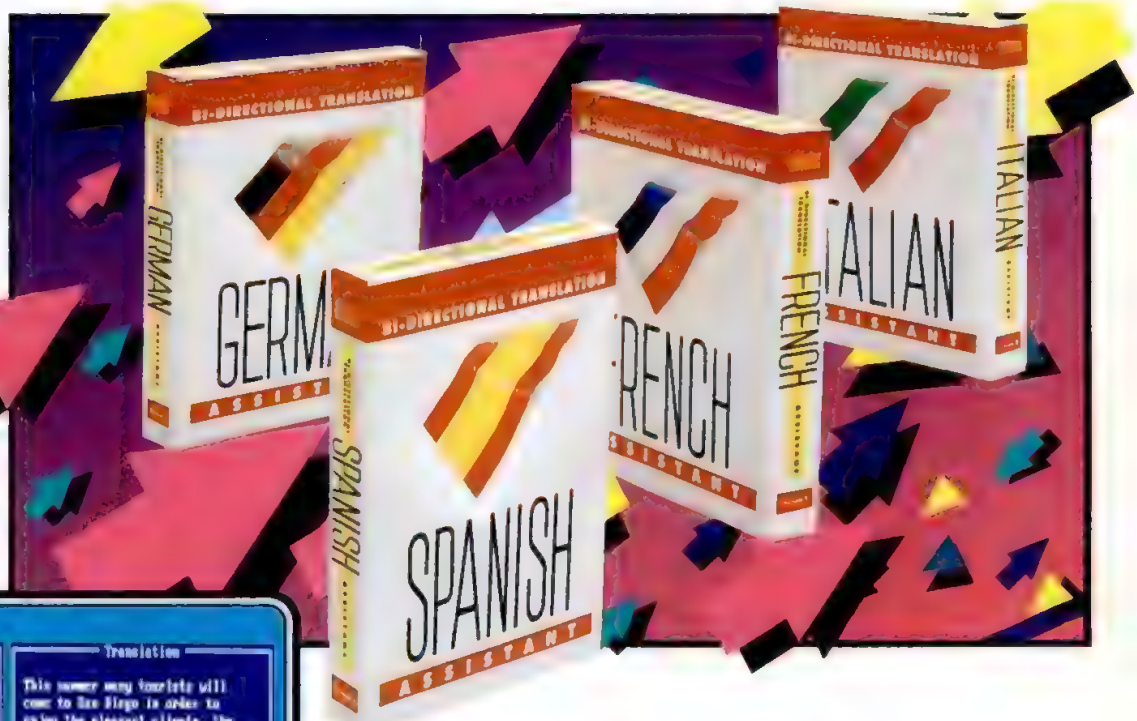

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display has been replaced by a 9-inch monochrome electromagnetic digitizer, and the hard disk is preinstalled with Microsoft Windows for Pen Computing. Any Z-Note can be upgraded to a Z-Notepad for $1,199.

• List price: *ZDS Z-Notepad 425Ln, $2,999. Zenith Data Systems, 2150 E. Lake Cook Rd., Buffalo Grove, IL 60089; 800-553-0331, 708-808-5000; fax, 800-472-7211.*
Circle 419 on reader service card

NEW

Boca's New Modem Is Like Having a Secretary in Your PC

When you put **Boca Research**'s new Multimedia Modem in or alongside your PC, you've installed a low-cost messaging center. The new voice/data/fax modem, which comes with Windows-based voice and fax software, has an automated attendant feature that lets you check, answer, and leave messages when you dial into your PC. For instance, if you've received faxes at your PC while you're on the road, you can have those faxes forwarded to a fax number at your hotel when you dial into your Multimedia Modem.

If you work in a group, the modem can be set up to handle up to 999 mailboxes. The unit is capable of routing calls to each extension, and the attendant lets you transfer among mailboxes. The Multimedia Modem has built-in intelligence that detects voice and/or fax transmissions, enabling you to dial into a mailbox, leave a message, and then attach a fax. The fax modem operates at 9,600 bps while the data modem works at 2,400 bps.

• List price: *Boca Multimedia Modem, $169 (internal), $215 (external). Boca Research Inc., 6413 Congress Ave., Boca Raton, FL 33487-2841; 407-997-6227; fax, 407-997-0918.*
Circle 417 on reader service card

NEW

Commix SP Takes the Work Out Of Making Multimedia Databases

Commix SP is shipping MultiMaster for OS/2, a tool for organizing images (including Kodak Photo CD images), sounds, and video clips for use in multimedia database applications. MultiMaster's intuitive interface lets you point-and-click and drag-and-drop multimedia elements without any programming. By drawing boxes around "hot spots" in certain images, you can drop another image, sound bite, or video clip on the spot and the software automatically sets up a link. Once you set up simple selection buttons for querying your multimedia catalog, you can use MultiMaster's presentation mode to create an attractive front-end and then port the database to DOS and Windows platforms (or Compact Disk Interactive) in a run time version.

• List price: *MultiMaster for OS/2, $195. Commix SP Inc., 8201 Greensboro Dr., #451, McLean, VA 22102; 800-226-6649, 703-356-9858; fax, 703-356-6148.*
Circle 418 on reader service card

IMPROVED

CoStar's AddressWriter Now Comes with Windows Software

It's been a while since **CoStar Corp.** took the Editors' Choice award for envelope printers with its AddressWriter (May 12, 1992). Now the hardware/software solution comes with Windows-based software (DOS and Mac versions are also available) that includes a full-featured application for designing templates, managing mailing lists, and printing envelopes. The package also includes a Windows printer driver for using the AddressWriter from any Windows application and a set of macros for accessing the software from the toolbars of Ami Pro, Microsoft Word for Windows, and WordPerfect for Windows. The 8.7- by 8.5- by 8-inch (HWD) AddressWriter itself is a dot matrix printer that attaches to a serial port and holds up to 100 envelopes.

Now you can control the AddressWriter through its Windows software.

CoStar is also shipping a Windows version of its LabelWriter II that is similar to the Windows software for the AddressWriter. In addition, Version 2.0 of LabelWriter II for DOS now has features such as a WYSIWYG label preview, scalable fonts, and bar code support. If you bought either product after June 1, you're entitled to a free upgrade.

• List price: *AddressWriter for Windows, $399 ($39.95 upgrade for DOS users); LabelWriter II for Windows, $249.95 ($39.95 upgrade for DOS users); LabelWriter II for DOS, Version 2.0, $249.95 ($19.95 upgrade). CoStar Corp., 100 Field Point Rd., Greenwich, CT 06830-6406; 800-426-7827, 203-661-9700; fax, 203-661-1540.*
Circle 416 on reader service card

BRIEFS

SOFTWARE UPGRADES

display menus in multiple windows rather than lists, and to launch programs with a mouse click. 404-446-6611.

Midisoft Corp. has announced an upgrade to its award-winning music-authoring and editing software, Midisoft Studio for Windows. Version 3.10 ($249.95; $149 95 to upgrade) has a Mixer View that lets you adjust loudness, panning, and other controls on each of 32,000 tracks just by pointing and clicking. The Score View now supports drag-and-drop, so you can edit music by dragging notes or groups of notes to new locations. 206-881-7176.

SofNet is shipping FaxWorks Pro, Version 3.0 ($129.99), emphasizing its ease of use under Windows. The new version has an automatic installation feature that checks your fax modem setup and makes the settings. It also includes annotation tools, cue card help, fax forwarding, optical character recognition (OCR), and a cover sheet creator. In addition, the new version provides a management system that will archive, find, log, and index faxes. 800-432-996757 (4-FAXWORKS), 404-984-8088

Symantec Corp. has announced version 4.0 of The Norton Commander ($99), the DOS-based shell utility that helps you manage, view, compress, and uncompress files. Commander 4.0 supports all the major compression formats and has over 30 new file viewers, including Lotus 1-2-3 3.*x*, Microsoft Excel 3.*x* and 4.*x*, and Microsoft Word 1.*x* and 2.*x*. Commander Mail lets you send faxes, telexes, and paper mail through MCI Mail to recipients who are not necessarily MCI subscribers. 800-441-7234, 408-252-3570.

Witzend Software's DOS-based pocket word processor, Witzend Editor, is now in version 2.0. The $59 product only requires 100K of memory and 19K of disk space, but it now includes spell-checking, multilevel undelete, and point-and-click file selection. 800-875-4571, 206-439-9371.

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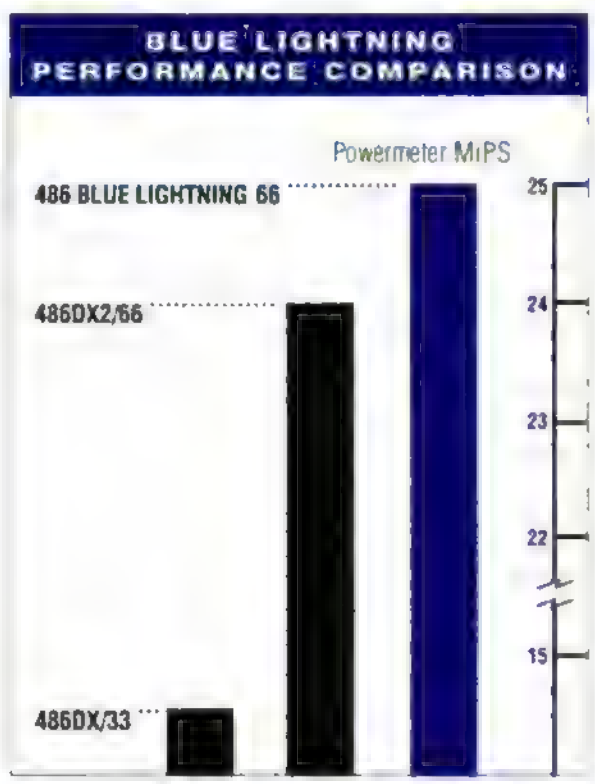

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External clock	33 MHz	33 MHz	33 MHz
System case	Desktop	Desktop	Desktop
RAM	8MB	8MB	8MB
Cache	**256KB**	128KB	—
Floppy	One	One	One
Hard disk	340MB	340MB	340MB
Onboard SCSI	✔	—	—
Local bus	✔VESA	✔VESA	✔
Video	Win accel w/1MB	Win accel w/1MB	Win accel w/512KB
Color monitor	15" FST*	15" FST	15" FST
Pentium-ready	✔	✔	✔
DOS 6.0, Windows 3.1, mouse	✔	✔MS Works for Windows	✔
Network-ready	**Ethernet (10BaseT)**	—	—
Tech support	24 hours, 7 days/week from **IBM**	Mon-Fri, 6am to midnight Sat, 9am-4pm	24 hours, 7 days/week
Warranty/Service	1 year **IBM onsite**	1 year onsite	1 year onsite
Price	**$2,078**	$2,025	$2,699

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Cache	256KB	256KB
Floppy	One	Two
Hard disk	**540MB SCSI**	500MB IDE
Onboard SCSI	✔**Dual 32-bit**	—
Local bus	✔VESA	✔
Video	**ATI™ Ultra Pro w/2MB DRAM**	Win accel w/512KB
Color monitor	15" FST*	15" FST
DOS 6.0, Windows 3.1, mouse	✔	✔
Tech support	24 hours, 7 days/week from **IBM**	24 hours, 7 days/week
Warranty/Service	1 year **IBM onsite**	1 year onsite
Price	**$4,250**	$7,566

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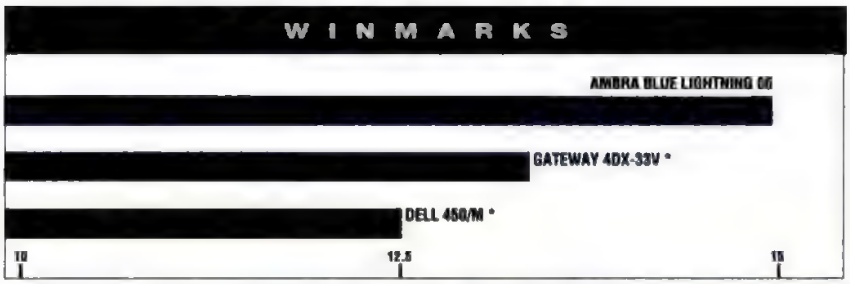

*Results measured in millions of Winmarks™ Reported in *Window Sources* (Ziff Davis), June 1993. Call AMBRA for specifics of this graphics Winmarks test.

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REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Carol Levin

Is There Life After IBM?

BY DON WILLMOTT

In *Computer Wars: How the West Can Win in a Post-IBM World*, authors Charles H. Ferguson and Charles R. Morris act like forensic pathologists, giving IBM a slightly premature autopsy and studying the causes of death so that other high-technology corporations competing in the twenty-first century can avoid the same fate.

A lively autopsy it is. IBM's downfall is seen in retrospect as the inevitable result of a lethal mix of bad decision making dating back to the 1950s, Japanese cheating, and government antitrust meddling that drained both financial and psychological resources from IBM for a decade.

Ferguson and Morris focus on IBM's failed Project F/S in the early '70s and run right through IBM's crucial PC stumbling in the '80s, including the RT PC (lesson: Don't bring a product to market late and over-priced), the PC*jr* debacle (lesson: Don't tell the market what it needs, give it what it wants), the Micro Channel fiasco (lesson: Don't try to impose new standards when you know it's too late to do so), and, more devastating, IBM's prolonged and nasty surrender of control of the winning operating system to Microsoft. As the authors put it, "For IBM, the OS/2 story is a Greek tragedy."

Less entertaining but perhaps more important is the second half of the book, in which the authors lapse into business-school lingo to lay out success strategies for high-tech competitors of the future.

They analyze and praise the "architectural" strategies of Nintendo and other American business models of the past and present and then pinpoint the advantages of the Silicon Valley Model: When you position at the center of the business the developers and protectors of the architecture you're trying to get the market to adopt, all the peripheral support groups fall into place clearly. Think Microsoft and Windows.

Finally, the authors look at high-tech opportunites over the next ten to twenty years, suggesting ways government can actually help American business stay ahead of the world, mainly by funding basic research and by moving faster to set technological standards for things like high-definition TV and communications.

Computer Wars explains the perils and possibilities of high-tech business with one eye on the past and one eye on the future, offering plenty of insight in both directions.

• **Computer Wars: How the West Can Win in a Post-IBM World,** *by Charles H. Ferguson and Charles R. Morris, $23. Times Books; 212-751-2600. ISBN: 0-8129-2156-9.*

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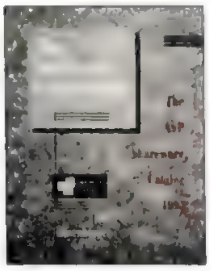
—*Computer Wars*, page 241

The Shareware Compendium

BY J.W. OLSEN

Wading through the overwhelming selection of shareware products can be a frustrating but ultimately rewarding exercise. After all, spending less money on software that gets the job done as well as or better than its retail, higher-price counterparts is smart. If you're in the dark about the diversity of shareware offerings, need a product that just isn't available on retail shelves, or want a single source of current shareware, *The Shareware Compendium* belongs on your bookshelf.

The 700-page catalog showcasing nearly 1,100 products is based on the electronic listing that's continuously updated by editor Rob Rosenberger, lead sysop for CompuServe's Shareware forum. Rosenberger foregoes lengthy discussion of shareware subculture in favor of practical listings of products, vendors, distributors, and BBSs. Each listing contains product name, author, latest version, system requirements, registration fee (i.e., price), filename and on on-line systems, filesize, as well as brief product description.



The Shareware Compendium's strengths lie in thoughtful organization, solid cross-indexing, and editorial integrity, but it does have two weaknesses. Since it doesn't comparatively evaluate software, product descriptions are written by their respective authors, not by independent critics. And, as publisher, the Association of Shareware Professionals (ASP) limits coverage to products from ASP authors and distributors. Though the largest shareware trade association, the ASP comprises only a portion of the industry.

Thanks to the size of the ASP, the fact that most active shareware authors are members, and the editor's clear focus, the catalog casts a wide net to help you identify shareware worth pursuing. □

The Shareware Compendium: The ASP Shareware Catalog 1993, *by Rob Rosenberger, $24.95. Business One Irwin; 800-634-3966. Or, Association of Shareware Professionals; 616-788-5131. ISBN:1-55623-914-9. Circle 457 on reader service card*

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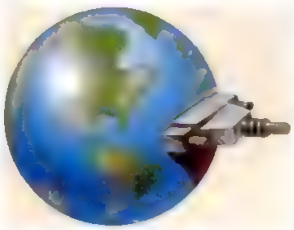

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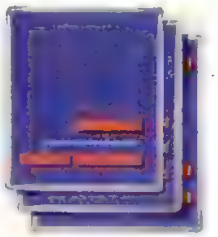

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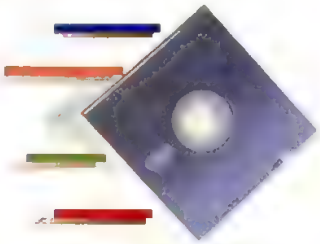

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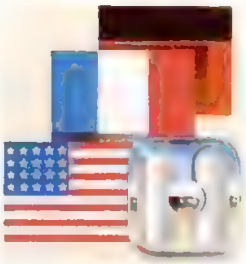

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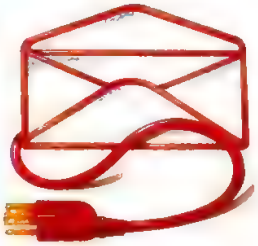

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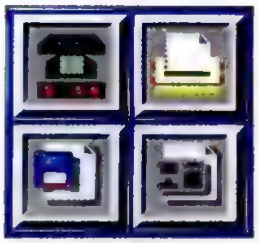

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Toolkits

REVIEWS OF THE LATEST TOOLS FOR THE PC PROGRAMMER

Edited by Trudy Neuhaus

Bring Your DOS Programs To Life with Fastgraph 3.00

BY J. W. OLSEN

Is your program feature-rich and fast, yet lifeless? Could your DOS programs' display routines use a healthy shot of adrenalin? The prescription just may be the powerful, versatile Fastgraph, Version 3.00, from Ted Gruber Software.

Fastgraph's functionality ranges from video initialization, through graphics and character display, to powerful animation, all available in a wide array of video modes up to 1,024-by-768 resolution in 256 colors. (Most popular SVGA chip sets are supported, as is any SVGA graphics board with VESA compatibility.) Fastgraph can find and automatically use conventional, EMS, and XMS memory for its operations and—in some video modes—can create virtual video pages by allocating ordinary RAM and treating it as video memory.

A 700-page tome combines an exceptional user's guide and a traditional reference manual. In the user's guide, you'll find everything you need to know—even if you're adding full graphics capabilities to a program for the first time. And the reference manual introduces functions logically, documents them well, and points you to examples on-disk as you navigate the text. All this plus substantial sample files, unlimited technical support, and access to the company's BBS is reasonably priced at $199. (No royalties are required.) Fastgraph supports several popular C/C++ compilers—such as those from Borland, Microsoft, and Zortech—as well as QuickBASIC, Turbo Pascal, and Microsoft FORTRAN. Fastgraph 3.00 also works with assemblers from Microsoft (MASM) and Borland (TASM).

Installing Fastgraph is straightforward and requires anywhere from 500K (one memory model for one environment) to 4.5MB (all memory models for all environments); allow 1MB to install all memory models for one compiler.

With more than 200 functions, this toolkit meets the graphics display needs of most serious developers. Space constraints prohibit listing all the function categories here, so I will just cover key categories.

You can initialize video by interrogating available video modes with Auto, Manual, or Best mode functions. Thereafter, if an available video mode is suitable for your program's needs, you use a library function to set the mode. In Auto mode, a return value indicates the video mode offering maximum available resolution and colors. Alternatively, functions can manually identify hardware resources, then initialize mode and display characteristics of your choice. Best mode returns the same information as Auto mode, but takes into account developer-specified video requirements.

Fastgraph boasts abundant functions you can use to establish coordinate and color systems. Coordinates may be established for common physical screen space, character space (columnar orientation, which facilitates displaying text fonts), and "world" space (programmer-defined areas of the physical screen). You can create your program to use the full range of colors for each video mode, or you can use virtual colors, which will be translated into the range of colors for the current video mode.

The graphic primitives function set is substantial, from lines and relative lines through circles and polygons to area fills. Special effects include panning, scrolling and fading graphics in and out. If you write programs for games, educational programs, and most categories of business tools, this function set will meet your needs. However, its omission of functions for direct manipulation of pie charts, histograms, and so on makes it less desirable for developing a product with intensive data display requirements.

Fastgraph's supplemental functions reflect its significant game-developer customer base. The product can adequately manage mouse and joystick input but provides minimal keyboard support (single-character input and manipulation of NumLock, CapsLock and ScrollLock status). And while the keyboard handler intercepts input ahead of the BIOS, making it well-suited to fast-action games and the like, this could lead to some potential conflicts in multitasking or task-switching environments. An even dozen functions (two of which are Tandy-specific) support modest sound effects, though only through built-in PC or Tandy three-voice output speakers.

Fastgraph truly excels in animation. Within 30 minutes of opening the box and choosing a few standard PCX, GIF, and RLE image files, I had a *PC Magazine* logo displayed in the background, with objects floating at varying speeds in random foreground paths. And while many features justify the *Fast* in Fastgraph, no feature demonstrates it better than Fastgraph's animation. Even complex, overlaid animation is flicker-free and responsive to user input.

Everything Fastgraph does, it does well. My only reservations about Fastgraph concern what it doesn't include. While font-display functions are available, fonts—and tools to create them—are not without separate purchase of Fastgraph/Fonts ($49). In addition, the toolkit lacks the ability to print what it displays so well. However, if you're like me and prefer to mix and match libraries for what they do best, neither of these omissions will be a problem.

Within its limitations—well-reasoned for its core audience—Fastgraph is powerful and disarmingly fast. Act fast yourself and get a copy of this toolkit so you can breathe life into your DOS products! □

• Fastgraph, Version 3.00
List price: *$199.* Requires: *Microsoft C, Borland C++, Turbo C/C++, QuickC, Power C, Zortech C++, Turbo Pascal, QuickBASIC, Microsoft FORTRAN, Microsoft Assembler, or Turbo Assembler. Ted Gruber Software, P.O. Box 13408, Las Vegas, NV 89112; 702-735-1980; fax, 702-735-4603.*

Circle 451 on reader service card

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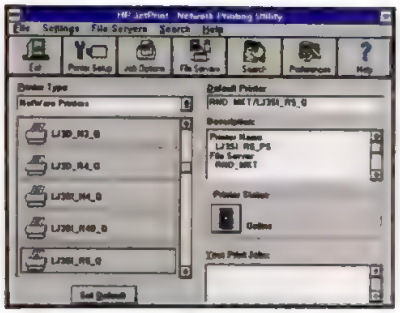

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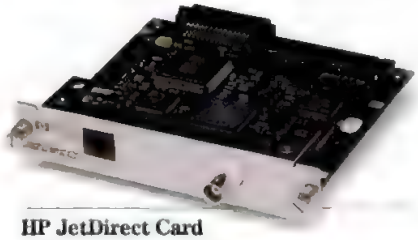

HP JetDirect Card

HP Printer Compatibility:

JetDirect Cards –
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JetDirect EX Interface –
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Supports industry-standard SNMP-based network management software.

*Multiple network operating systems are supported simultaneously with the HP JetDirect card when installed into an HP LaserJet 4Si or 4Si MX printer.
'Only NOS supported by JetDirect EX interface.
''Not supported with Token Ring topology

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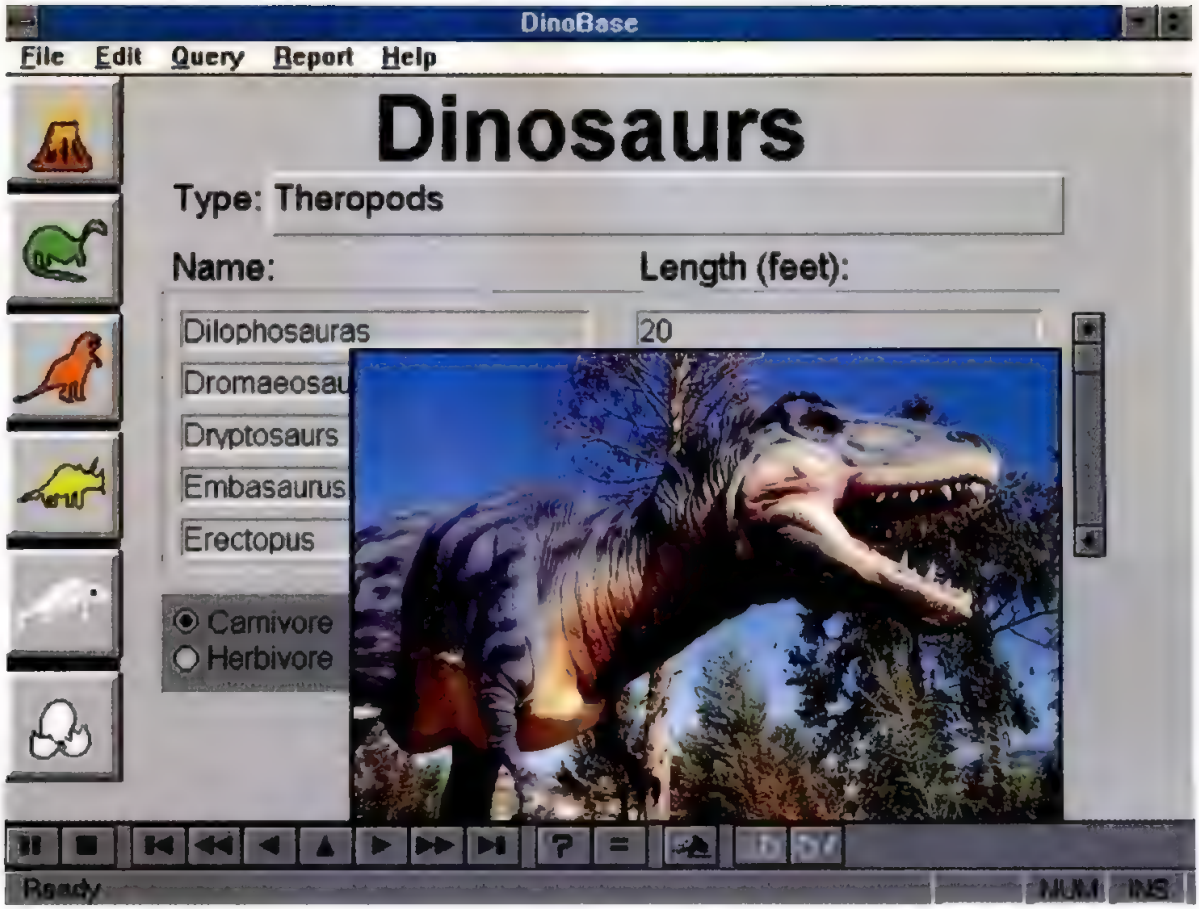

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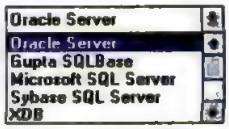
You'll feel right at home with Super Basic Language (SBL), which is similar to Visual Basic. SBL is highly optimized for data access and is loaded with a procedure library with over 100 application-ready routines and functions. Not only that, RAVE tools automatically generate *bi-directional, reusable* source code as you build apps on-screen. And when you need to work out a bug or two, just click into our full-featured debugger.

While everybody's talking about multimedia, Superbase is making it happen. With our extensible image API, support for 15 image types, video players, and MCI, you can add lots of spice to otherwise ordinary applications. There's also a royalty-free, multi-user runtime license (available separately), so you can share your dynamic applications with anyone.

Superbase can get into just about anything you're into. Our Superbase SQL Library (available separately) supports more back-end SQL servers than any other product. Plus, Superbase directly reads and writes data from dBase® files, and accesses Paradox® data.



Superbase version 2.0 recently won Windows Magazine's 1993 Win Award. In fact, Superbase has been winning awards for years.

Superbase is so advanced, it makes all other databases seem, well, prehistoric.

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Michael J. Miller

Yet Another Dinosaur?

At a crucial point in *Jurassic Park,* a preteen girl walks up to a computer and says "I know this! It's a Unix system." Are they kidding? Another joke is the concept that today's PCs are dinosaurs that will be supplanted by some computer-television-telephone hydra. It's that kind of science fiction. Someday, it may happen, but not for a while.

HOT TOPIC

Still, everyone is talking about interactive media and the coming convergence of personal computers, television, and telephones. It's the hot topic in the industry today, and everyone is grabbing to get a share of this brave new world. Microsoft and Intel are trying to define standards for integrating computers and telephones. So are AT&T and Novell. Everyone seems to be scrambling to get in some sort of alliance for developing standards for connecting computers and cable. Standards may make strange bedfellows: Look at the recent alliances including Apple, General Instruments, IBM, Microsoft, Scientific-Atlanta, Tele-Communications, and Time Warner in varying combinations. A lot of this new technology is exciting, and I'm sure we'll see some amazing new devices.

The concept is certainly alluring. I would love to have more choices on my television, to see new kinds of information and games, or to combine information access and entertainment viewing. I can see new devices that will make it easier to shop, play games, and learn on both televisions and computers. Adding computer technology to telephones and televisions, or vice versa, is very interesting, but these new devices will not replace the personal computer.

SLOW SPEED AHEAD

The first thing to note is that any form of convergence isn't going to happen overnight. The "information highway" everyone talks about is very expensive. It will cost billions and billions of dollars to run the fiber-optic cables most people think are necessary to carry all of the information we will want. It will require a lot of rewiring and rebuilding of the existing cable television and telephone networks. (I don't expect that we will need fiber everywhere. Fiber to the curb, and existing copper wire into and through the home or office should suffice.) The information suppliers and distributors will also need tons of large, expensive, fault-tolerant servers that store and distribute all of the available programming.

I'm convinced that eventually all of this will happen, with or without government regulation. Most of us already have two information networks running into our homes (telephone and cable), and we're on the verge of having a third wireless communications alternative. Simple competition should guarantee that we will get the bandwidth we need. But we aren't going to wake up anytime in the next year or two and find that the network is in place and interactive media is readily available.

The current fragile state of the technology and the tremendous cost of the equipment means that this technology will get rolled out in stages.

Even when the convergence is complete, we won't be left with one device that functions as a combination computer-television-telephone. Such multiheaded hydras would be too unwieldy for most people. Instead, I expect that telephones, televisions, and computers will remain separate devices for a long time to come, albeit with some technology from each migrating to the other platforms.

Will one multiheaded device replace the PC? When was the last time you saw a jogger wearing a 486 with earphones?

COMPUTER IN THE CABLE BOX

For instance, I expect you will be able to order a movie or choose from hundreds of channels via your television's cable box. This will involve a computer in

Illustration by Paul Schulenburg

the cable box, and some personal computer companies may well get involved in designing the cable converter, the software that runs it, or the user interface for choosing among systems. Still, the end result will be a more capable television, not a machine you would want to use for word processing, spreadsheets, or accounting.

Similarly, I expect that a more intelligent telephone system will be developed—one that will allow you to store more numbers and that will add features such as voicemail or routing information electronically to PCs and fax machines. You may even be able to control this from your computer. But it won't *be* your computer.

You might even have a device that acts as your "personal communicator," with some computer features and built-in telecommunications. This new device may have some computer functions via pen or voice input, but it's not going to take the place of today's notebook computers. Why? Because if it has a readable screen and a keyboard that's good enough to type on, it will weigh too much to take the place of a telephone.

HAVE YOUR PC CALL MY PC

You might well have telephone and television capabilities built into your computer. For years, we've been able to dial calls from our PCs, or create voice mail. Video capabilities are growing as well. However, I expect video products to follow in the footsteps of CD-ROM players and sound boards. Yes, you can play music on your computer, but that fact hasn't ended the era of separate audio players. I haven't seen too many joggers wearing 486s with earphones. And I really don't want "General Protection Faults" on my television.

The complete convergence of these technologies is a long way off, if it ever comes. But we're already seeing the benefits of some of this convergence. Interactive CD-ROMS using ideas at least borrowed from movies and video is allowing for a new level of realism in games, better animation, and better learning tools. Look at titles such as Broderbund's amazing Just Grandma and Me. We've seen an incredible amount of information available in CD-based reference works (such as Microsoft Bookshelf and no less than three full encyclopedias), and these are getting more interactive. These techniques are finding their way into business titles as well, with CD-ROM-based software coming with tons of "content" (another new buzzword, often simply meaning a lot of clip-art and sample files).

In fact, I expect to see CD-ROM drives and sound boards become standard equipment on a huge proportion of systems sold within the next six months. These won't be the "multimedia PCs" we have seen in previous years; they are full-featured fast PCs with additional equipment.

EVOLUTION = SURVIVAL

Most of the plans you hear about combination television-telephone-computers seem to me to be underdeveloped, and probably five to ten years away from being ready for the mass market. Even then, I have a hard time picturing one device that really does it all. But in the meantime, I expect to see more ways for these devices to communicate with one another, and amazing new capabilities added to the features of telephones, televisions, and computers.

After all, the dinosaurs proved that everything has to evolve to survive. □

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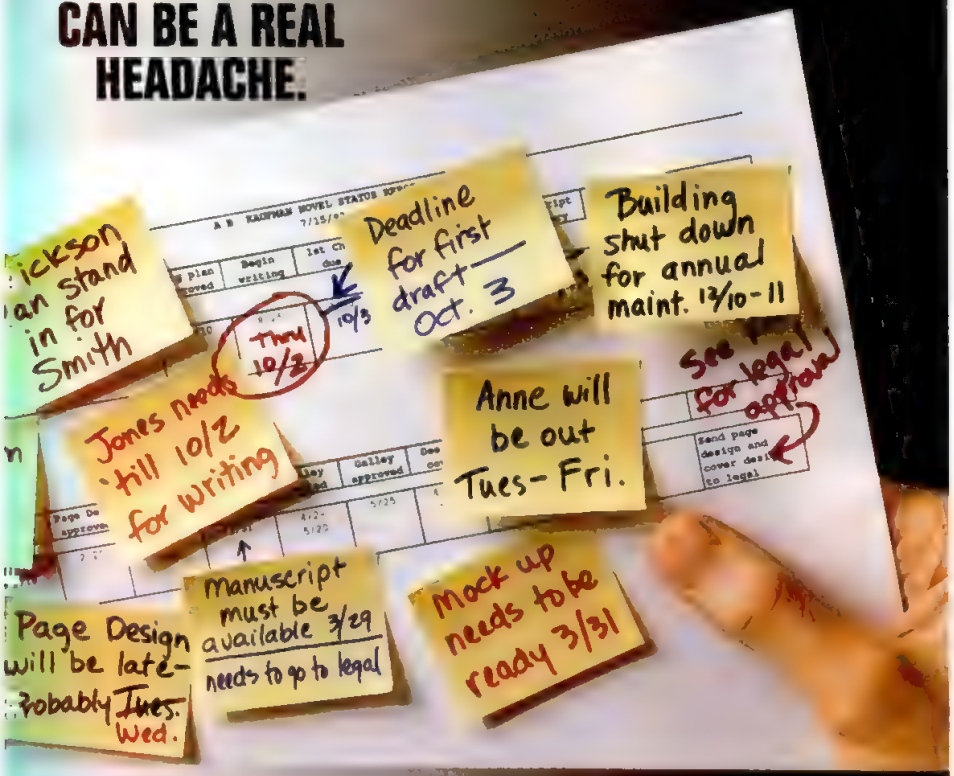
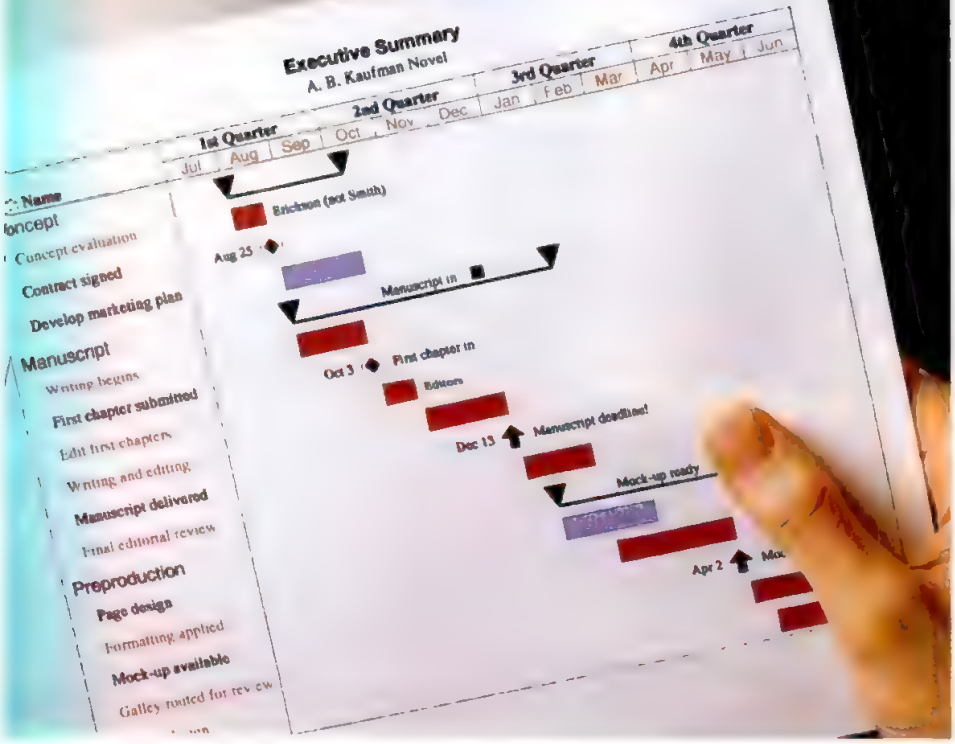
ON ONE HAND, PROJECT MANAGEMENT CAN BE A REAL HEADACHE.



ON THE OTHER HAND, WHY SHOULD IT BE?



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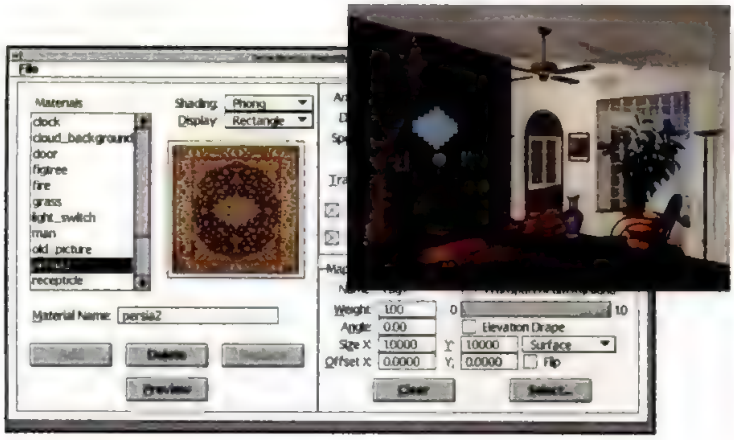

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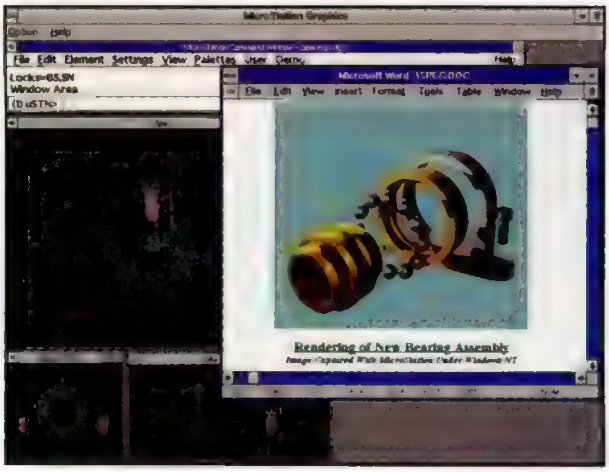

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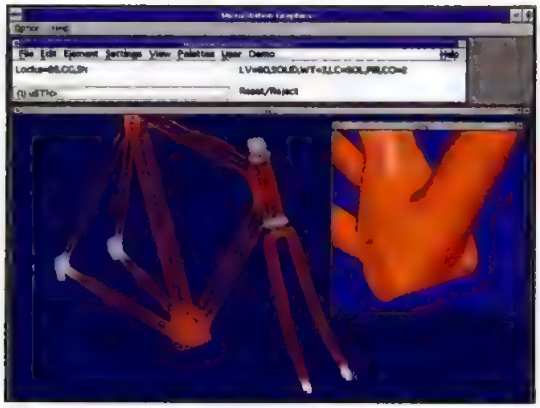

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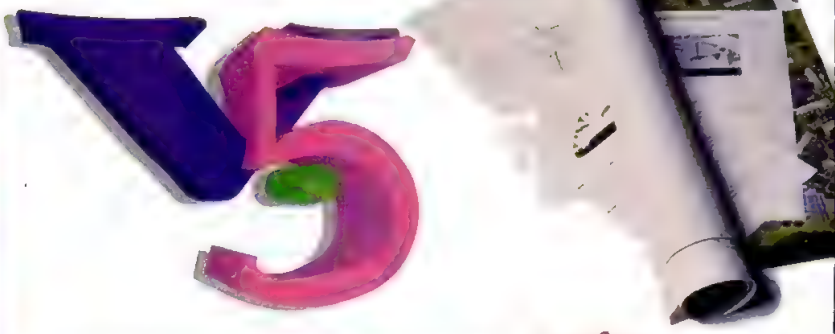

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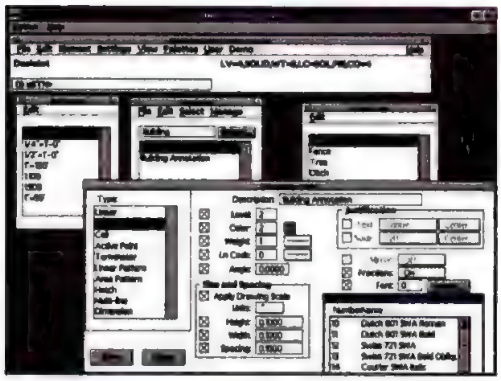

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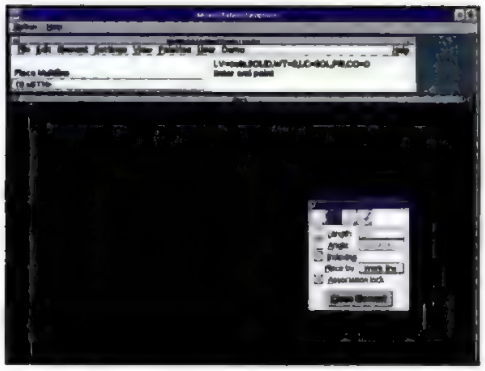

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CIRCLE 337 ON READER SERVICE CARD

Bill Machrone

Your Next Operating System?

Inertia is a terrible thing—if you're trying to sell the world a new operating system. Back in 1987, IBM and Microsoft (and many of us in the trade press and the upper echelons of the computer-buying public) held to the fatuous belief that everyone would move up to OS/2. Of course, the product was the living definition of a day late and a dollar short, and we turned our attention back to DOS and Windows.

Hope, however, springs eternal in the human heart. The designers never took their eyes off the distant, nearly unattainable goal of a 32-bit operating system that took advantage of the inherent power of modern processors and offered backward compatibility with desktop applications. Today, OS/2 2.1 is a testament to pursuit of that goal and the sheer dogged persistence it took to get there. OS/2 has clearly bested Windows NT in its ability to run 16-bit DOS and Windows applications along with native apps. OS/2 is, as IBM reminds us, here now, and it's winning hearts in Corporate America for its robustness, excellent development tools, and broad range of connectivity options. IBM says it's selling 300,000 copies per month. If OS/2 were anything other than an operating system, it would be a runaway bestseller. Operating systems, however, have always been a one-horse race. We don't know how to deal with multiple players, but we'll have to learn.

OS/2 is an operating system that's going somewhere. IBM has articulated plans to move OS/2 to a microkernel-based architecture that will implement object orientation, portability, and support for multiple CPUs. The result, Workplace OS, will be close to the state of the art.

NT, meanwhile, has changed its identity more often than an indecisive adolescent choosing the best outfit to wear to the mall. As of this writing, at least, Microsoft says that NT is not going to take over the world, that by the beginning of 1995 it will have, at best, 10 or 20 percent market share. Microsoft is ahead of IBM in offering multiple CPU support, but this first offering is limited. Sequent, NCR, Compaq, and others have been working with Microsoft on proprietary enhancements to NT that will enable it to handle more than four processors gracefully, and will make their multiprocessor machines faster and more efficient. Deals like this scare hardware manufacturers, who see Microsoft as a technology leveling agent. After you've developed a new technology with Microsoft, a version of it is likely to show up in the next release of Microsoft's operating systems, making it possible for others to compete in your formerly private preserve. De facto standards and Microsoft's blessing can potentiate a market, but often take the profit away from everyone except Microsoft.

Windows NT is far from a foregone conclusion in the operating system wars.

FISH NOR FOWL

The big question in my mind is whether NT is a server operating system or a desktop operating system. Microsoft has taken great pride in making the code identical between the two versions—Windows NT and Windows NT Advanced Server—but users may wind up buying a less-than-optimal system. NT's additional security, portability, and Windows heritage will be irresistible to some customers. Microsoft hopes that NT's feature mix will make it the platform of choice for a variety of workstations and desktops.

SunSoft's Solaris comes to the PC from the workstation market. Sun Microsystems, the world's largest purveyor of workstations, knows a thing or two about distributed operating systems. Solaris is attractive to companies with a big investment in workstations. If the IBM-compatibles in the front office need to dip into data and share e-mail with the

Illustration by Paul Schulenburg

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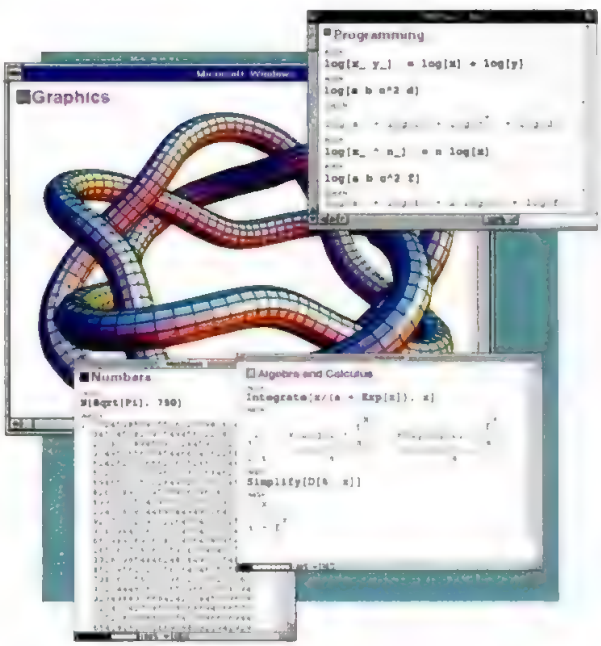

When it was released in 1988, the *New York Times* wrote that *Mathematica* "fundamentally alters the mechanics of mathematics." Four and a half years later, with several hundred thousand scientists, engineers, students, financial analysts, medical researchers, and others using the system, *Mathematica* is firmly established as the standard environment for technical computing.

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CIRCLE 271 ON READER SERVICE CARD

SparcServer-linked workstations in the lab, they've got just the system.

NeXTStep Development Environment is another one of those dark horses that's suddenly getting lots of attention and rave reviews from some corporate sites. NeXTStep is based on the same Carnegie-Mellon microkernel that powers IBM's Workplace OS. On top is arguably the best development environment available today. When NeXTStep was only available on NeXT machines, I saw a number of product demos where designers said, "This is what we're going to build for the Windows platform—as soon as we figure out how." Compared to NeXTStep's highly evolved, object-oriented tools, the tools and APIs in other environments are woefully archaic.

FUTURE PERFECT

Standing by to close the gap (and perhaps the door on NeXT and Microsoft) is Taligent. Funded by IBM and Apple, Taligent is aimed squarely at the ongoing problem of software trailing hardware. Taligent's immodest goal is a complete overhaul of the way we do software engineering. By making the entire operating system object-oriented, Taligent expects to lay to rest the longstanding criticism that object orientation hurts performance. Taligent developers won't have to worry about drivers and APIs, and they won't have to think about bypassing system software to gain performance. In what Taligent calls "frameworks," everything in the system has an object-oriented wrapper that lets it talk to virtually any other object. Thus the layering of APIs and operating system calls in today's systems vanishes. If, as everyone is expecting, the tools are a solid improvement over NeXT's, this will be one slick environment.

TODAY, TOMORROW, AND BEYOND

With TrueType support and vastly improved display and printer drivers, OS/2 makes an excellent case for itself as a mature operating system. If you're starting out fresh and need a robust development environment, it's the way to go. IBM's plans for Workplace OS should give developers confidence in OS/2's staying power. On the distant horizon, Taligent will still beat Microsoft's object-oriented offering, Windows Cairo, to market by a year or more. As the benefits of object orientation become more apparent, Taligent will make its mark. □

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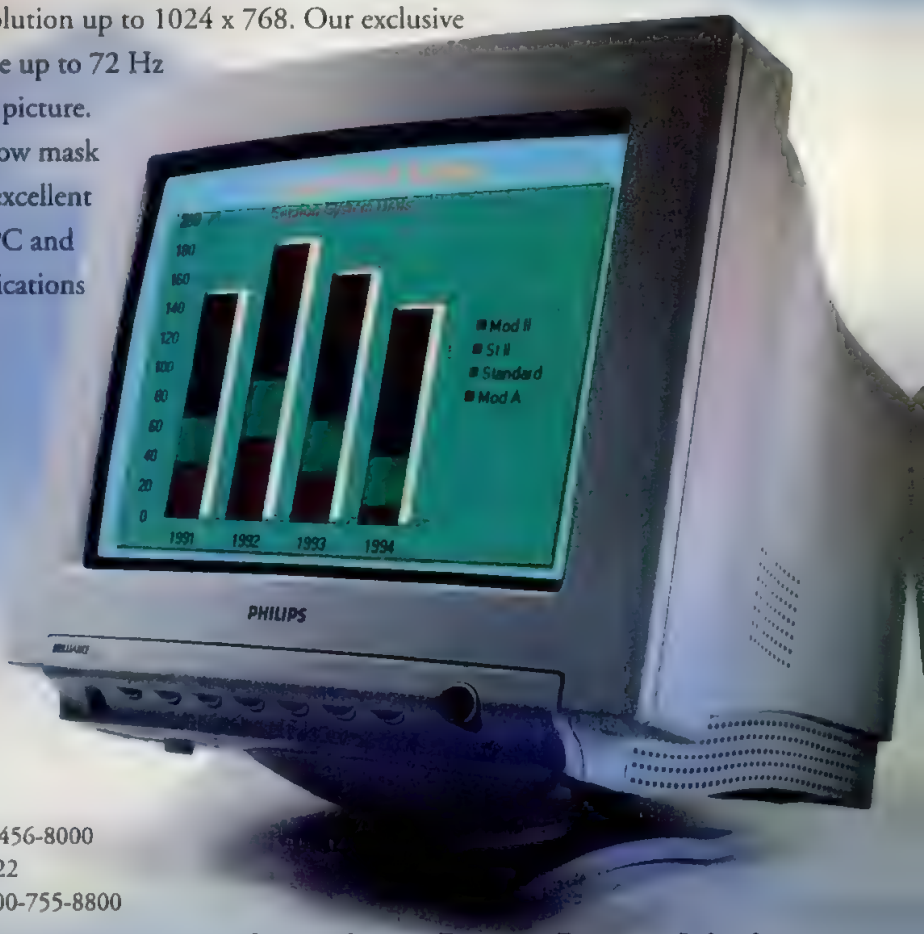

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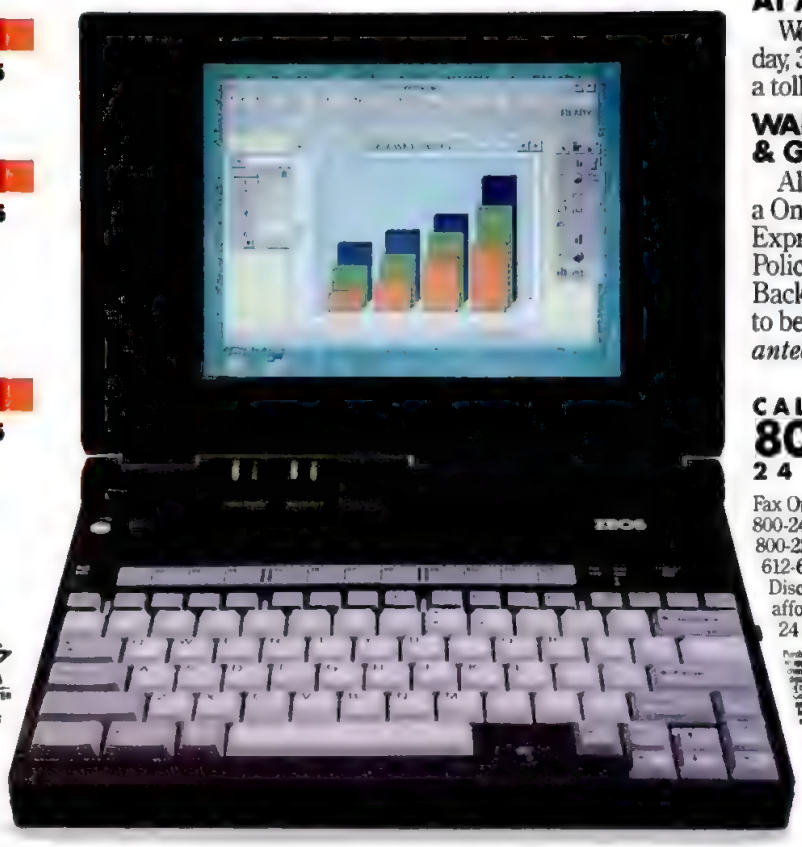

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John C. Dvorak

OS/2 Then and Now

Now that IBM has released OS/2 2.1 and threatened to put its marketing muscle (that is, *money*) to work selling it, we have to determine whether OS/2 is an operating system we should consider. This is especially important now that Windows NT is imminent and now that IBM is fighting with Microsoft, its former OS/2 partner. Let's look at why OS/2 flopped in the first place. Remember that when OS/2 was announced in 1987, it had already been in development for two years. So why did it hit the market with a thud right up until the release of Version 2.0 in 1992?

Let's examine OS/2's historical flaws.

1. Designed for a 286! This was ridiculous. Even today the two companies point their fingers at each other for this one. I believe Microsoft—the lead developer—was the culprit. When Microsoft specified its multimedia PC, it chose the 286. Windows was designed to run on a 286. And I'm convinced that Bill Gates had a fondness for the chip and was deeply hurt when pundits called it "brain dead."

2. Memory shortage. OS/2 needs memory, and it hit the market just as a massive memory shortage occurred. ($500 a megabyte!) Bad luck. This was a disaster.

3. Machine-specific. The biggest joke in the initial design of OS/2 was that it was machine-specific. It's hard to blame Microsoft for this one, although I'm convinced it helped promote the idea. IBM was in the throes of a debate over the direction of its desktop business. I'm told that both the PS/2 and OS/2 were attempts to divert business away from the mainstream and to make the desktop business proprietary. This happened during the Bill Lowe regime at Entry Systems. According to IBMers, John Akers was annoyed at the clone makers and made the public comment, "If the PC business is going to become a commodity business, then we don't want to be in it." To Lowe this meant, "Get out of the business." That's when the idea of the Micro Channel and OS/2 came about. OS/2 was supposed to be optimized for Micro Channel, and that didn't go over too well. IBM made it clear that the Micro Channel would *never* be licensed, which killed it instantly. I think it was during this period that Microsoft decided to dump IBM.

4. Minimum backward compatibility. DOS programs had to run through a DOS-compatibility box. There was no Windows support, and you couldn't multitask like you can today. It was geared for OS/2-specific applications of which there were few.

5. Expensive. While OS/2 was touted as the operating system of the future, Microsoft and IBM wanted to charge over $500 for it. Mass-market operating systems will *never* cost more than $100. OS/2 2.1's $49 to $100 street price is more like it. Since NT is priced similarly to the original OS/2, I have to assume Microsoft was behind the faulty price.

Now Windows enters the picture. While we all like to moan and groan about Microsoft, some of its success is simply due to dumb luck. Nobody expected Windows 3.0, and then Windows 3.1, to be killer products. Like OS/2, Windows had struggled from the day it was announced in 1987. But only a few observers were big boosters of OS/2, and that was largely based on technical considerations, not marketing concerns.

When OS/2 was introduced in 1989, its chances of success were about the same as those of Windows 1.0 when it shipped: Neither the market nor the product was ready.

Things have changed since that early release of OS/2. It's more powerful, cheaper, and generic. Machines to run it are affordable. Maybe 2.1 is the magic number. It's a pretty good deal for the price. At least give it a try. □

A history lesson recounts OS/2's troubled past and foretells its promising future.

Illustration by Paul Schulenburg

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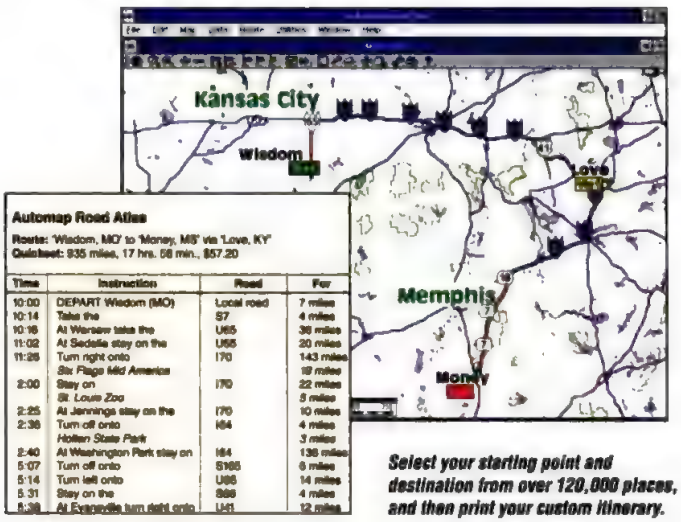

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10:14	Take the	S7	4 miles
10:18	At Warsaw take the	U65	36 miles
11:02	At Sedalia stay on the	U65	20 miles
11:26	Turn right onto	I70	143 miles
	Six Flags Mid America		*19 miles*
2:00	Stay on	I70	22 miles
	St. Louis Zoo		*5 miles*
2:25	At Jennings stay on the	I70	10 miles
2:36	Turn off onto	I64	4 miles
	Holten State Park		*3 miles*
2:40	At Washington Park stay on	I64	136 miles
5:07	Turn off onto	S165	6 miles
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CIRCLE 111 ON READER SERVICE CARD

John C. Dvorak

Inside Track

Horns of a Dilemma Dept.: So there I am roaming around the Client-Server Computing Show in Boston. There before everyone (and for the most part unnoticed by the **network rubes** schlumping around the show) is IBM's Personal Computer Company showing—get this—a **370 mainframe on a single Micro Channel card.** Designed by one of the superstar IBM Fellows at Poughkeepsie, it has one tenth the power of the largest mainframe IBM sells. One IBMer told me that the gate-array used on the card is probably the **most complex** ever developed. So the thing was sitting in the new IBM 295 file server and pretending to be a mainframe. You could walk over to a **ValuePoint** el cheapo machine and run **VM!** It was awesome, dude! (That's California talk for "wow!") And I must say that anyone looking for a **kick-butt** file server that looks expensive and substantial should check out the 295. It's something to behold. Dual 50-MHz 486, RAID 5, and it even has casters. I guess that means IBM is on a roll! (Get it?)

So anyway, the 370 is supervised by OS/2 on the network and is a mind-boggling piece of technology. It looks like the route to take if you're a mainframe house that's been told to **downsize** but have no easy way to do so. The gotcha here, though, is that **IBM hasn't got a clue** as to how to sell this thing. Here's what I was told by IBM (unofficially): "This board is a PC product and could probably be priced at $2,000. But to the users and that big mainframe market it might be worth $100,000 or more. Frankly, we don't know what to do with it. We're only showing it to get feedback from users." Think of the possibilities!

Interface Wars Dept.: Novell goes on the offensive with WABI. Apparently, Novell has managed to produce a Windows **Application Binary Interface** and intends to link it into the next release of DR DOS or make it an **add-in module.** The problem is that while Novell has the ability to run Windows programs, it doesn't have the Windows interface—or any GUI for that matter. I suspect that most of the vendors who do this sort of thing will use **Motif,** which seems pretty compatible with the Windows requirements. IBM, of course, will simply use the OS/2 parameters when it releases WABI code to allow Windows programs to run under **OS/2 native mode.** Well, it seems as if Novell might take the big step and **license the Macintosh user interface from Apple.** Insiders report that a deal was done and the Mac interface will be a front-end for Windows programs running under a Novell OS. **Holy Toledo.** Is this going to be complicated or what?

Insiders report that Novell and Apple have made a licensing deal and that the Mac interface will be a front-end for Windows programs running under a Novell operating system.

I think that the real battles of the 1990s will be fought on the interface front, where people **will choose the interface**—not the operating system—they prefer. This assumes that OS functionality stabilizes and you can indeed do real multitasking, for example, on all the systems.

Novell plans to incorporate **real multitasking** in future versions of DR DOS. The other DOS vendors will have to follow suit. IBM is planning a DOS 7 in 1994 that will use the OS/2 VDM (virtual DOS machine) kernel. Everyone assumes it'll use built-in multitasking. IBM will also put the **Workplace Shell on top** of its version of DOS, which will diverge from MS-DOS in a short time. Yes, there will be three distinctly different (but mostly compatible) DOSes on the market in the next year or so. They'll compete with the more advanced operating systems from Novell, IBM, Microsoft, and maybe even Sun and NeXT. It's **a bonanza** of confusion!

Unalterable Trends Dept.: If there's ever going to be a flood of **cheap monitors,** it'll have to wait until after all the expensive monitors flood the market. When that's over, the expensive monitors will be cheap.

It seems that every company that knows how to put some electronics on the back of a good tube will release monitors—mostly to compete with the NEC *x*FG line. That seems to be the target. **IBM** is going to create a monitor division to sell monitors to everyone. **Acer** is building a monitor plant in Taiwan to blow out 17-inch and eventually 21-inch hi-res tubes. **Philips** is bringing out a whole line of hi-res tubes. Even the Finnish electronics giant **Nokia** will enter the market with hi-res tubes that, I'm told, are "good looking!" Folks, this will be a **bloodbath.**

Apparently everyone sees that the graphical interfaces require better and larger displays. **Everyone wants 17 inches** for starters and will soon gravitate toward 21 inches. Resolution of 800-by-600 seems to be the minimum acceptable nowadays, with most users of 19- and 21-inch monitors preferring 1,024-by-786 res or higher. At this size, a noninterlaced monitor is **critical.** I laugh when people say that a notebook will be the only computer you'll need in the future. Obviously these people have never used Windows or OS/2 where a large screen is critical. □

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Jim Seymour

Mouse Games in Redmond

Many's the slip twixt the point and the click: Microsoft's introduction this spring of its hunky Mouse II drew attention to the new dynamics of what was once one of the sleepiest corners of the PC hardware market.

Microsoft wasn't alone in rolling out new pointing products. Other vendors, especially Logitech, have brought interesting new pointing devices to market this year as well. Few have gotten much attention, but as usual, when Microsoft stirs, the PC industry sits up and takes notice.

And when Microsoft replaces a big-selling, highly successful design—the circa-1988 Bauhaus Maus that had become a standard on corporate America's desks without any apparent reason—you can be sure something interesting is afoot.

In my last column, I described the new Microsoft Mouse as humpbacked, with a pronounced dog leg. You might describe Microsoft's motives in developing and positioning the mouse in the same way.

$10 MILLION IN RESEARCH

The new Microsoft mouse came to market with a flourish of smoke and mirrors. Gorgeous black-and-white photos of human hands graced ads recounting Microsoft's extraordinary research—more than $10 million was spent, by one Microsoft insider's guess—into how the hand works and also how a mouse should fit the hand.

Privately, Microsoft claimed there had been substantial user demand for a better mouse. But it's at least possible that Microsoft was driven by two less-evident instincts.

First, Microsoft wanted a new design because it has been under assault by the $5-mice people from Taiwan. Microsoft makes a pile of money from the DOS/Windows/Mouse bundles it peddles to PC OEMs, but in these cost-conscious times many OEMs were taking just the DOS/Windows bundle and buying their mice elsewhere for a lot less.

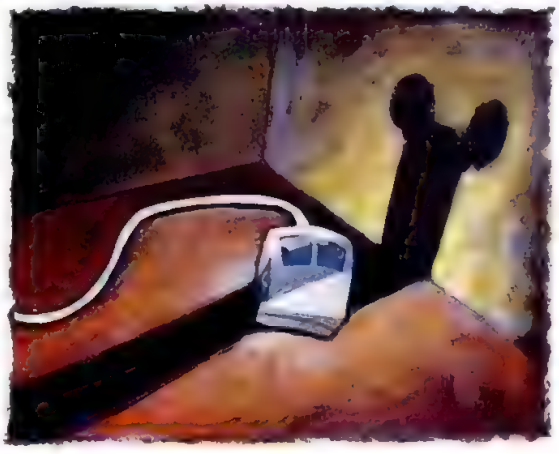
Microsoft needed something new and different-looking to suggest a more valuable device, which in theory would bring those OEMs back into the fold.

Second, Microsoft might also have been worried about lawsuits over repetitive-motion injuries. It's already facing one suit as a joint defendant with IBM, over injury from alleged faulty design. By enlisting a huge corps of ergonomics and medical experts to help design a new mouse, Microsoft could build a defensive wall against further litigation, and make those experts unavailable to plaintiffs who might someday sue Microsoft.

After all, of the 50 million or so mice in use, about 14 million have come from Microsoft. Get a little class-action suit going, invite unhappy Microsoft Mouse users and the just-plain-litigious among those 14 million users to join in, and—well, Bill Gates might start worrying about the payments on his new house.

But the product manager swears to me that those thoughts never darkened his brow; so let's say Microsoft really did just want to make a better mouse and started afresh. In an era when many consumers equate smallness and sleekness with goodness, was a big, heavy, lumpy, dog-leg mouse really a smart idea?

Yep. Because to use the new Microsoft Mouse is to come to love it—though not necessarily right away. It *does* feel better than the old mouse. It's nice to anchor the heel of your hand on your desktop and let the hollow of your hand rest atop that fat lump in the middle of the mouse. And the new microswitch design lets you click with equal pressure anywhere on the buttons and get a nice, clean, rapid,



Attention, conspiracy theorists: When Microsoft builds a better mouse, there might be a reason.

Illustration by Paul Schulenburg

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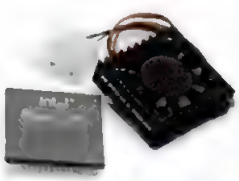

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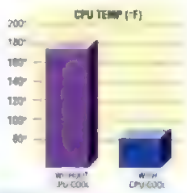

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easily-double-clickable action.

But wait: There's more! The best part of the new Microsoft Mouse isn't the hardware, it's the software. A completely new mouse-driver package installs easily and makes customizing your mouse's performance a delight. (It will also, believe it or not, gobble up more than a megabyte of disk space. Whatever happened to the 13K MOUSE.COMs and MOUSE.SYSes of the past?)

The new Driver 9.0 has several clever tricks, but my favorite is that it always snaps the cursor to the default button (usually but not always the OK button) when Windows puts up a dialog box.

WORKS WITH ANY MOUSE

Best of all, the new driver works with almost any Microsoft Mouse-compatible pointing device. You should at least try the new dog-leg Microsoft Mouse, but if you already have a pointing device you like, you can buy just the Driver 9.0 kit for $19.95 by calling Microsoft at 800-426-9400. You'll probably be asked for the serial number of an existing Microsoft Mouse, so have it handy before you call.

Microsoft could have done even better. The new mouse is so large that some users with small hands will find it clumsy. If Microsoft had produced a second model about 70 percent as large, it could have made a lot more users happy. And though Microsoft claims, bizarrely, that this dog-leg design so carefully calculated for right-hand use is just fine for lefties too, it really should have produced a mirror-image model in two sizes, for Bill Clinton and other PC-using southpaws.

This year's new mouse designs, taken together, mark the biggest improvement in pointing devices since I began using digital rodents more than a decade ago on a Xerox Star workstation. The range of choices is amazing, with more *good* ones than ever.

For me, the new dog-leg Microsoft Mouse has nearly pulled into a tie with my long-time favorite, Kensington Expert Mouse trackball for desktop use. Logitech's new radio-wave MouseMan Cordless is just a half-step back. The TrackPoint II device, built into IBM's 700-series notebooks, is my overwhelming favorite for portables, and if a separate TrackPoint-equipped keyboard should appear, it could make it a three-way tie for desktop machines. □

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> *1-2-3 leapfrogs Excel and Quattro...*
> *–PC World 6/93*

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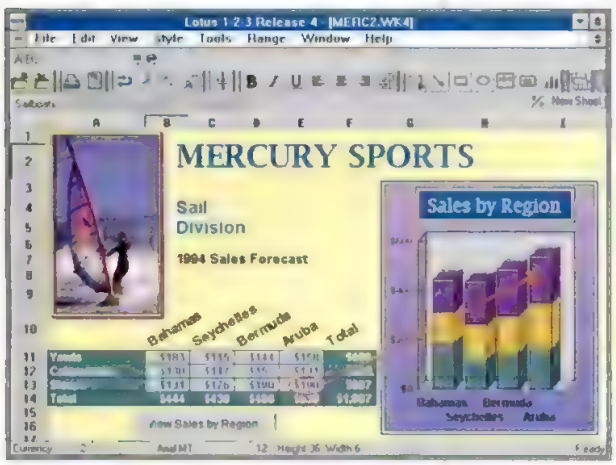

While adding dozens of major new features, hundreds of macros and hundreds of tools and @ functions, Lotus has actually simplified the way you work in a spreadsheet.

For example, Release 4 features an @ function pull-down menu to help you build spreadsheets faster. Cell copying is now a simple drag-and-drop operation, with meaningful visual feedback. And changing text and font attributes is done in one dialog box. (Excel often requires three.)

So 1-2-3® is not only a lot friendlier and easier to use than any other spreadsheet, it's a significant advance over Microsoft® Excel in usability.

THE FIRST CONTEXT-SENSITIVE USER INTERFACE.

> *The SmartIcons in 1-2-3 for Windows are smarter, and Lotus' approach to swapping different tool-bars in and out beats Excel's and Quattro Pro's.*
> *–PC Computing 6/93*

Release 4 actually anticipates what tools and functions you'll need. Depending on what you're doing, 1-2-3 presents only the menu choices and **SmartIcon**™ palettes appropriate to the operation at hand.

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> *–BYTE 6/93*

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> *It (Version Manager) also makes Microsoft Corp's Scenario Manager in Excel 4.0 look like a toy by comparison.*
> *–PC Week 5/3*

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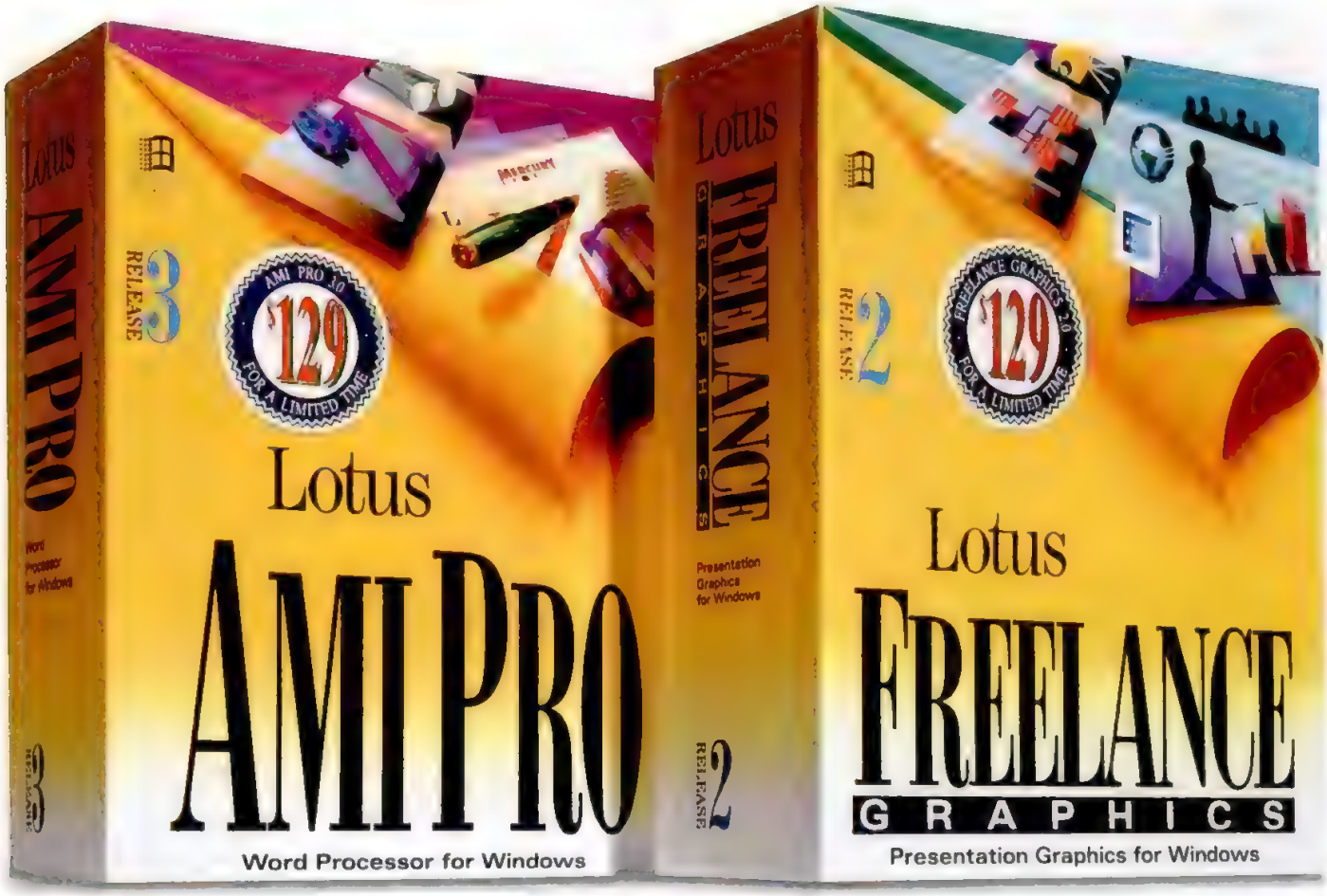

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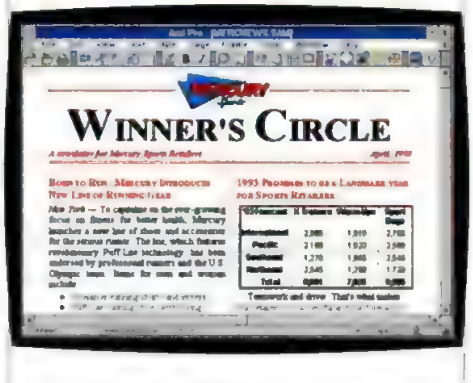

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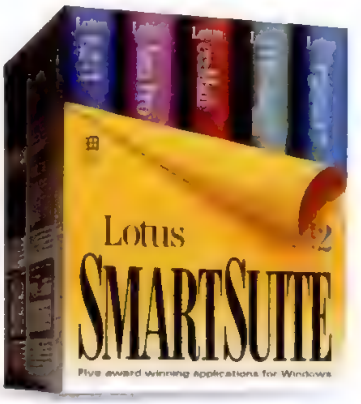

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Bill Howard

No Such Thing as No Compromise

No-compromise subnotebook is a contradiction in terms—like military intelligence, congressional ethics, or rap music. All subnotebooks carry compromises, but users find the systems' usefulness outweighs the drawbacks. Recent subnotebook PCs improve substantially on those you could buy a few months ago. That means they're good, but not great.

Today's subnotebooks include the Dell 325SLi, Epson ActionNote 4000, Gateway 2000 HandBook, Hewlett-Packard OmniBook 300, IBM ThinkPad 500, Twinhead SubNote, Zenith Data Systems' Z-Lite, and Zeos Contenda. A subnotebook is basically a notebook with features taken out to bring the weight down to 4 pounds. The internal floppy disk drive goes; you may also lose backlighting, 486 power, hard disk space, long battery life, screen size, standard connectors, a pointing device, and a full-size keyboard. These compromises also help keep the cost below $2,000—what today's users are willing to pay for portables lacking features.

Hewlett-Packard and IBM took different tacks to arrive at the summer's most talked-about subnotebooks, the HP OmniBook 300 and the ThinkPad 500. If you want a truly small, light, go-everywhere notebook and you can live without a backlight, then the OmniBook is a 2.9-pound marvel. If you want something that looks and acts like a regular notebook but is smaller—with a much smaller backlit screen and a little bit smaller keyboard—then you're a candidate for the 3.8-pound ThinkPad.

The 6- by 11-inch OmniBook appears more visionary: It has a full-size keyboard, a built-in mouse that slides out from the side, and an infrared I/O port for talking to printers and PCs. DOS, Windows, Excel, and Word for Windows are embedded in ROM—available within 2 seconds of hitting On/Resume.

After carrying the OmniBook for several weeks, I agree that it's wonderful to have an ultra-light, instant-on device. But, oh, the gotchas. The CPU, an AMD 386SXL/25, doesn't cut it today, especially on a system that boots into Windows. HP started work on OmniBook well back in 1992 and codenamed it Lion. Given the gestation period, Elephant would have been appropriate. Under DOS, there's only about 475K free.

With a 40MB PCMCIA-based hard disk installed, battery life runs 4 hours. (For longer battery life, you can substitute the 10MB flash-memory disk, but it adds $400 to the price.) In a pinch, you can use AA batteries, but HP recommends lithium batteries (just try finding them in the airport gift shop). Or consider file sharing: HP doesn't offer an external floppy disk drive; right now, the infrared link works just with HP's machines. And because HP didn't include a floppy, you have to use a serial cable to install Traveling Software's LapLink Remote on your desktop PC.

In comparison, the IBM ThinkPad 500 is based on a serious CPU: the clock-doubled IBM 486SLC2/50. You can get hard disks as big as 170MB; the external floppy drive is included; and if you don't want to carry a transformer, there's an integrated plug that lets you attach the battery directly to the wall outlet for charging. This system isn't as sexy as the OmniBook, but it works.

Today's subnotebooks are better than their predecessors, but the ideal subnotebook still hasn't arrived.

As much as I like the OmniBook and ThinkPad, I still haven't seen the ideal subnotebook: full-size keyboard, backlit 9.5-inch screen, 486-class CPU, built-in pointing device. Using lithium ion batteries and 1.8-inch hard disks, the weight should come in at 4 pounds. A color version—oh why not?—would be 5. Who might do it? Well, three of the heavy hitters—Compaq, NEC, and Toshiba—have yet to chime in. □

Illustration by Paul Schulenburg

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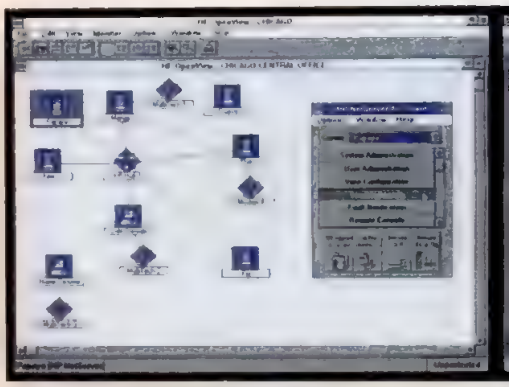

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HEWLETT PACKARD

You get a host of utilities for free when you upgrade to MS-DOS 6. But can they hold their own with the established thoroughbreds of memory management, backup, and on-the-fly data compression?

by Rick Ayre

It is the best of times. It is the worst of times. Now that MS-DOS provides its own suite of utilities essentially for free with DOS 6, it may be one or the other for utilities software vendors. Certainly, change is in store for vendors whose financial well-being depends on income from disk compression, memory management, backup, and virus-protection software sales. Their wares have got to do better—significantly better—than what Microsoft is giving away with DOS 6.

Microsoft engineered its bid to dominate the utilities turf in stages, getting its foot in the door (exactly as Norton did) by introducing undelete in DOS 5. With DOS 6, Microsoft throws down the gauntlet. They haven't just tossed in a few more goodies, they've included the *most popular* utilities: memory management, backup, disk compression, and antivirus. And don't imagine that this is a kind of afterthought; Microsoft is touting DOS 6 as the *easiest way* to double the space on your hard disk, the *easiest way* to optimize memory, and the *best way* to live safely with DOS.

If demand is a measure of success, then the DOS 6 strategy seems to be working. According to Microsoft, DOS 6 sold 3 million copies in its first six weeks, the most successful launch of a software product—*ever*. Let's face it. Microsoft is giving you what you want—at least in theory. But don't think for a moment that the utilities vendors are lollygagging around while DOS 6 takes over. All of the vendors in this review have roared to market with improvements that up the ante.

In this story, we bring the considerable resources of PC Magazine Labs to bear on the questions of just how good the DOS 6 utilities are and just how well they compare with existing and new utilities. We also look at safety, reliability, and ease of use. Specifically, we test on-the-fly disk compression, memory management, backup, and data recovery.

We compare DOS 6's DoubleSpace disk compression program with Stacker 3.1, SuperStor PRO 1.01, XtraDrive 3.0, and DoubleDisk GOLD 6.0. We then compare EMM386/MemMaker with QEMM-386 7, 386MAX 7, and NetRoom 3.0. We compare DOS 6 Backup with The Norton Backup 2.2 for DOS and for Windows, Central Point Backup for DOS 8.0 and for Windows 2.0, and Fastback Plus for DOS 6.0 and for Windows 1.0. We compare the DOS 6 Undelete with similar utilities that

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DOS 6 UTILITIES vs. THE COMPETITION

What's the Price

of a Free Lunch?

Illustration by Jeff Brice

come with The Norton Utilities 7 and PC Tools for DOS 8.0. (For a look at DOS 6's competition on the antivirus front—DOS 6 incorporates a version of Central Point Anti-Virus—see our recent coverage, "Antivirus Software: Keeping Up Your Guard.")

Further, you'll find a sidebar that compares disk optimizers and programs that manage multiple configurations. Another sidebar surveys the new DOS 6 add-on utilities from Addstor and Vertisoft Systems, which complement DoubleSpace rather than compete with it. In still another sidebar, we compare DOS 6 with the newest versions of the venerable Norton Utilities and PC Tools from Central Point Software. What do these packages give you that DOS 6 leaves out?

Finally, you'll find a thorough discussion of the controversial subject of disk caching software, with a focus on the technology—write-behind caching—that we think is creating some problems.

DOUBLE TROUBLE?

Certainly, the most controversial of the new DOS utilities is the compression utility, DoubleSpace. Real-time disk compression has always seemed like those TV weight-loss adds—too good to be true: If by using software you can double the space on your hard disk without sacrificing performance, where's the catch?

It turns out that real-time disk compression, DoubleSpace or any other, is a risky venture. It's not that disk compression is inherently unsafe. It's just that adding disk compression leaves you more vulnerable. Problems such as a bad sector or a heavily fragmented disk—merely a nuisance in an uncompressed world—become serious matters when your disk is compressed.

FEATURES PLUS

You can find out more about these utilities from August 23 through 27 in ZiffNet's Executives Online forum. Join host Rick Ayre and guests from several of the utility software publishers. Type GO EXEC at any CompuServe prompt.

A common misperception assumes that if the compressed data is stored in one file, you can lose one file and lose all your data. This is not true. The compressed volume file in DOS 6, or CVF as Microsoft calls it, has its own data structures, file allocation table (FAT), and the like, and it still works the same way as regular DOS file access. If you save a file to a bad sector on your hard disk, you'll lose the file, regardless of whether or not the file resides in a CVF.

Still, recovering from file errors is a little trickier when the errors occur in a CVF. For example, a cross-linked file, wherever it occurs, is a nuisance. If you can't recover, you're likely to lose at least one file, possibly more. If the cross-linked file happens to reside in your CVF, whose file-repair programs can you use?

The diagnostic and recovery tools that come with DOS 6 are minimal. Those that come with Stacker 3.1 are far better. The new Norton Utilities 7.0 comes with a complete set of tools designed to work with DoubleSpaced disks. We recommend Stacker's compression because of its built-in tools, but if you use DoubleSpace, get The Norton Utilities 7.0.

It's not just a matter of the types of problems you'll encounter; it's also a matter of frequency. How often might these problems occur? Test as we might, we don't have the data to answer that. Microsoft has offered a few statistics, such as a *projected* rate of data loss for all DOS 6 users at only .05 percent. But it is not sharing the results for its long-term stress and frequency testing.

PC MAGAZINE ▶ EDITORS' CHOICE

- **Data Compression: Stacker for Windows & DOS**
- **Memory Management: NetRoom**
- **Backup and Restore: No Editors' Choice**
- **Data Recovery: The Norton Utilities**

Our Editors' Choices comprise an eclectic lot, including Stacker 3.1 for Windows & DOS; NetRoom, Version 3.0; and The Norton Utilities, Version 7.0. We could not choose a winner among backup programs, and the winners in two of the three other categories were very difficult to choose (but we should be used to this by now).

DATA COMPRESSION

Let's not dance around the big question facing real-time disk compression: Is it safe? Our answer is, "Yes—almost as safe as computing without it." But that "almost" may make it more of a gamble than you want to take.

It's like those weight-loss commercials that say you can lose 30 pounds in 30 days eating anything you want. It's too good to be true. Thing is, we can't exactly explain why.

We did a great deal of focused testing, and we definitely encountered problems. None, however, could be reliably duplicated, and they were so few that they could be explained as testing anomalies. While these results were not conclusive, they were enough to give us pause. We're therefore not ready to recommend disk compression. We can, however, recommend the best product if you decide to chance it.

The issue of data safety loomed large during our selection process. Both the products that preload their device drivers—Microsoft's DoubleSpace and Stac Electronics' Stacker 3.1 for Windows & DOS—go a long way toward eliminating the blatant kinds of data-loss dangers hitherto associated with on-the-fly compression schemes. But only Stacker goes the extra mile, providing numerous safety features aimed at minimizing the kinds of risks that stem from faulty disk media.

Stacker racked up some of the best

performance figures here and showed the very best compression ratios. Even so, all compression users should own as good a set of compression-compatible data-recovery tools as they can find.

MEMORY MANAGEMENT

Microsoft's inclusion of a serious memory manager with DOS 6 lends weight to our view that memory management is now a tool for all users, not just power users. And Microsoft's MemMaker/EMM386 combination, is more than enough memory manager for most.

But users who want more must choose from among the three established contenders, NetRoom, QEMM-386, and 386MAX, and the call is a close one. All three work wonders. But a word of caution: All are brand new and untested in the broad market. In the weeks between testing and press time, Quarterdeck Office Systems began shipping QEMM-386, Version 7.01, which fixes some disconcerting bugs, and NetRoom is already up to Version 3.02 (mostly to handle multiconfiguration). But memory management is still a bit like nuclear power: so efficient, yet still a little dangerous. And the dilemma is the same: When it works, it works well, but when it doesn't. . . Our decision: NetRoom is the new champ; it offers the best memory recovery, and you won't have to sacrifice performance.

BACKUP AND RESTORE

Microsoft Backup is a great improvement over the old DOS Backup and Restore, but it works only with floppy disks and removable media. The Norton Backup packages have reached a higher plain, but they don't work with SCSI tape drives. The Central Point packages have a file selection interface that is awkward. We therefore found it impossible to select an Editors' Choice from these performers.

We instead suggest buying a tape backup system and using the software that comes with it. With drive sizes increasing and the use of disk-compression software on the rise, the amount of data that needs to be backed up is becoming so large that the only convenient *and* reliable backup is done to tape.

DATA RECOVERY

Our last category yielded our only hands-down winner. Version 7.0 of The Norton Utilties, with its host of data-recovery tools (including Disk Editor, The Norton Disk Doctor, and Undelete), is absolutely the best data-recovery software we have seen. Not only that, but Symantec Corp. has added tools to enhance the utility's ability to work with DoubleSpace and Stacker. In sum, The Norton Utilities is not only a safe buy, it's a *must* buy.

We do know, as our review indicates, that Stacker does about as good a job of making this business safe as is currently possible, and DoubleSpace comes in a close second. Neither, however, has managed to reduce the risk to zero.

How do we know? Because we experienced problems while preparing this review—with *all* the disk compression programs we tested. More accurately, we experienced problems on disks where each of the programs was installed. In one case, data was lost; in most cases (with some time and effort), we were able to repair the damage without losing data.

The single most important safety feature is the ability to load the compression device drivers before CONFIG.SYS is executed. This feature, introduced by Microsoft in DOS 6, virtually eliminates the likelihood of data loss through inadvertent editing or overwriting of CONFIG.SYS or AUTOEXEC.BAT files. The driver is loaded through a hook to IO.SYS in the DoubleSpace boot sequence. Stacker 3.1 also can preload, just like DoubleSpace. XtraDrive 3.0 preloads a replacement for the BIOS, but its compression driver loads like a "first generation" compression product.

As we write this, Microsoft claims that more than 62 percent of its DOS 6 buyers are using DoubleSpace—a huge group, considering that DOS 6 users number in the millions. With the rapid acceptance of DoubleSpace came reports of problems involving data loss. While systematic reliability testing is beyond the scope of our own resources or anyone else's, our performance tests found DoubleSpace to be as dependable as the other compression products tested. We believe that disk caching may be a factor in some of the problems people are blaming on DoubleSpace. Our sidebar on disk caching examines this subject in detail.

The other news on the compression front is the Microsoft Real-Time Compression Interface, or MRCI (variously pronounced as *merci*, as in the French, or *mercy*, as in granting some). Microsoft has made this specification available to those wishing to license it without fee. Third-party vendors can use it to preload their drivers. Repair utilities, such as those in Norton Utilities 7.0, can use it to ensure that they are compatible with DoubleSpace. Hardware vendors can create MRCI-compliant compression acceleration boards.

MEMORY GAINED

The second most important DOS 6 utility is MemMaker, Microsoft's answer to QEMM-386, 386MAX, and NetRoom. As network drivers, CD-ROM players, and other memory-hogging devices increase in popularity, memory managers gain a serious market share. QEMM-386, the market leader, is consistently a top-ten software best-seller.

MemMaker is good news for those who want more from a computer's memory, without necessarily having to know a lot about it. MemMaker is as easy as, if not easier than, any competitor, its undo feature being the best we've seen.

While MemMaker may not reclaim as much memory as others in this roundup, it is useful to remember that the challenge does not entail a race to see which

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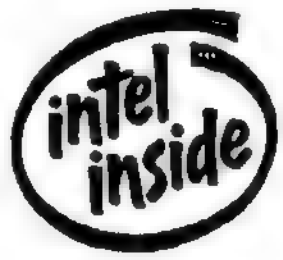

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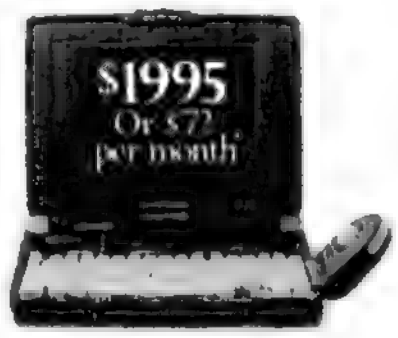

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One-Stop Utility Shopping

by Edward Mendelson

If you're lucky enough to have the world's only immortal hard disk, and your software never locks your computer, the utilities that come with DOS 6 will be all you need to protect your data. If you live in the real world, however, you'll probably feel safer with add-on utilities. But which ones?

Your first purchase should be backup software. DOS 6 backs up only to floppy disks and DOS paths. Few souls have the patience to back up today's large hard disks to floppy disks; realistically, you need a tape drive and software that works with it. If you use QIC 40/80 tape, the Norton Backup and Central Point Backup packages—from Symantec Corp. and Central Point Software, respectively—are fine, well-established options. The Norton packages are marginally faster when backing up; the Central Point programs are faster on restores of individual files.

Until the Norton programs support SCSI tape, one of the Central Point packages may be your first choice, although they support only Adaptec SCSI controllers. If you want breathtakingly fast SCSI backups and restores and you don't mind a rather clumsy interface, you should order the $135 DOS-based NovaBack package from NovaStor Corp. (30961 Agoura Rd., Westlake Village, CA 91361; 818-707-9900; fax, 818-707-9902). A character-mode OS/2 version is also available, and a Windows version should be available by the time you read this article.

After backing up your disk, you next need a general set of disk utilities. The most powerful are those programs found in The Norton Utilities.

KITCHEN SINKS

After backing up your disk, you next need a general set of disk utilities. The most powerful are those found in The Norton Utilities. The package's disk editor lets you restore files even from disks too damaged to be accessed by DOS 6, and its Norton Disk Doctor program automates more kinds of disk repair than anything else available. The Unerase program lets you rebuild files that DOS 6's Undelete can't even recognize. Speedisk can defragment files in DoubleSpace drives; DOS 6's Defrag can't. The Norton Cache, also in The Norton Utilities, is faster and smaller than DOS 6's SmartDrive. The package includes a dozen other valuable utilities. Only The Norton Utilities offers emergency rescue utilities disk right out of the box to recover a system that won't boot up.

The Norton Desktop for Windows includes the key emergency utilities from The Norton Utilities, but experienced users will want the power of Norton's disk editor, which isn't included in the Windows package. You do, however, get a Windows version of The Norton Backup in The Norton Desktop for Windows.

PC Tools for DOS doesn't lag far behind The Norton Utilities in disk repair programs and disk editors, and it comes with a cornucopia of menu utilities and desktop accessories that you won't find in the Norton package. PC Tools for Windows includes emergency utilities from the DOS version and has the

package can find the most. Rather, it entails all users finding as much as they need for themselves. In our tests, MemMaker did well enough to be a sufficient memory manager for many.

If MemMaker doesn't reclaim enough memory for you, select the advanced technology in QEMM-386's Stealth, NetRoom's cloaking, or 386MAX's ROMSearch. These take memory management to its outer limits, reclaiming memory that, in some cases, you wouldn't guess exists. Because they all use aggressive techniques, 386MAX, NetRoom, and, most especially, QEMM-386 can cause problems. QEMM-386, Version 7, for example, was updated with a series of bug fixes almost the instant it shipped. Most of the problems can be attributed to esoteric hardware and software combinations, and while we believe the latest version of QEMM-386 will ultimately be a stable product, we'd urge caution in these early stages.

BACKUP IMPROVED

Backup is something we should all do—but very often don't. It's that simple, and it may just be that the reason we don't backup more often is because it's too complicated to do reliably. MS-DOS Backup is a big improvement over the old DOS Backup and Restore. Yet it's still not a program that is going to inspire users to back up their work.

Third-party programs offer more features—in particular, support for tape drives—and more specifically defined backup and restore procedures. And since backing up to tape *can* be simple, and is relatively inexpensive these days, we urge users to consider purchasing a tape backup system (with its own software) rather than new backup software.

DATA RECOVERY RECOVERS

Undelete was the first step on the road that brought us here. It turned Peter Norton from an obscure programmer into a philanthropist and trendy art collector. Clearly utilities worked for someone.

Data recovery began with undelete and moved on to unformat. It takes care of two kinds of errors with different success rates. Undelete is a great way to get out of an accidental slip, "Oops, I meant to delete *.DOC, not *.*." Unformat, on

unique ability to repair some disk damage from within Windows. PC Tools for DOS includes a copy of Central Point Backup for DOS; PC Tools for Windows includes a copy of Central Point Backup for Windows.

DOS 6 includes most of what you need to shield your disk against viruses, but you'll get the ultimate in protection from either The Norton AntiVirus or Central Point Anti-Virus. Version 2.0 of the Central Point program, just released, is probably the most advanced package of its kind, but earlier and still effective versions come with the DOS and Windows varieties of PC Tools.

If you're seeking a single package to supplement DOS 6, and you spend much of your working day in Windows or DOS, your best choice is clearly either PC Tools for Windows or PC Tools for DOS. If you want the ultimate in protection for both DOS and Windows, start with the backup package that suits your needs and a copy of The Norton Utilities. Then supplement these with PC Tools for Windows and perhaps also Central Point Anti-Virus. And while you're out shopping, if you want even more peace of mind, buy an uninterruptable power supply to protect your system from power surges and power failures. □

the other hand, is seldom needed, often the last desperate attempt at recovery, and is not usually as successful.

Undelete works better now than ever because DOS, beginning with DOS 5, was designed with undelete in mind. By that, we mean that DOS used to start at the beginning of the disk and drop files in the first empty space it found, even if that space contained all or part of a previously deleted file. Now DOS keeps a pointer to the last written file, so it can start where it left off.

Undeleters should have a much greater likelihood of being able to undelete files, even after a significant amount of disk activity. Try Undelete. It might work for you. However, be cautioned that DoubleSpace broke the undelete that DOS 5 fixed: While undelete will restore files on a DoubleSpace volume, DoubleSpace cannot keep a pointer at the place of the last disk activity when you turn off the system. This could lead to overwriting areas of the disk you might want to undelete.

SUMMARY

So how do you decide whether or not DOS 6 is enough for you? Our tests indicate that DOS 6 is clearly easy enough, but whether it's safe enough or powerful enough is another tougher question. If we built our perfect PC, it would have DOS 6 installed but would use Stacker's compression. Our choice for the ultimate memory manager, right now, is NetRoom. It offers users the best performance with the least sacrifice. We'd also make an investment in The Norton Utilities 7.0 and in a tape backup system. Power users will want no less. Most users, though, will be well served by the utilities in DOS 6, and only you can decide what kind of user you are.

So much talk has centered around the utilities in DOS 6, and how they compare with the best of the breed in each category, that it's easy to forget that DOS 6 is, first and foremost, an operating system. By adding these utilities, Microsoft has clouded the definition of exactly what an operating system should be.

One thing is certain, as Microsoft stretches the limits of what an operating system provides, we are reaping huge benefits. Whether it's DOS 6 or the newer, third-party utilities, these are uniformly better and easier to use than their forerunners and cost a lot less. Isn't that what this PC thing is all about?

Data Compression

DoubleSpace Changes the Compression Landscape

Microsoft Corp.

Microsoft DoubleSpace

BY CHRISTOPHER BARR

With DOS 6's DoubleSpace, Microsoft Corp. took a popular niche-market utility, disk compression, and brought it into the mainstream. By offering compression as an integral part of the operating system (DR DOS, Version 5.0, was the first to do it with SuperStor), Microsoft has helped the market grow exponentially. The growth is a mixed blessing. DOS 6 is easy to use and safer than "first generation" compression products, but it falls considerably short of perfection. The groundswell of new compression users raises questions about the inherent safety of compression, as well as questions about the adequacy of Microsoft's diagnostic and recovery utilities.

LIKE AND UNLIKE OTHERS

Like other real-time compression products, DoubleSpace works through a memory-resident device driver that intercepts files as they are written to and read from the hard disk, compressing and decompressing them using a variant of the "lossless" Lempel-Ziv algorithm. Microsoft has made its compression format available to third-party vendors as the Microsoft Real-Time Compression Format (MRCF); it expects to be seeing compatible hardware and software utilities coming soon.

Like the others, DoubleSpace stores your files inside a hidden "container" file

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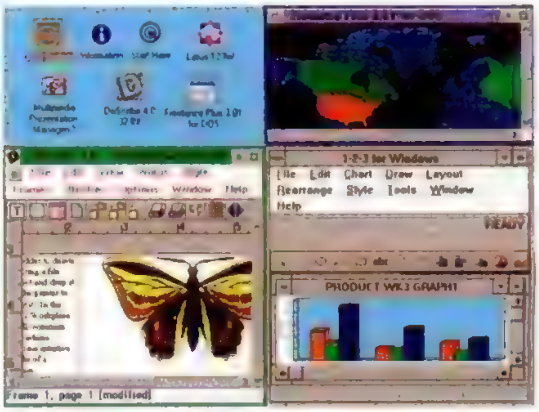

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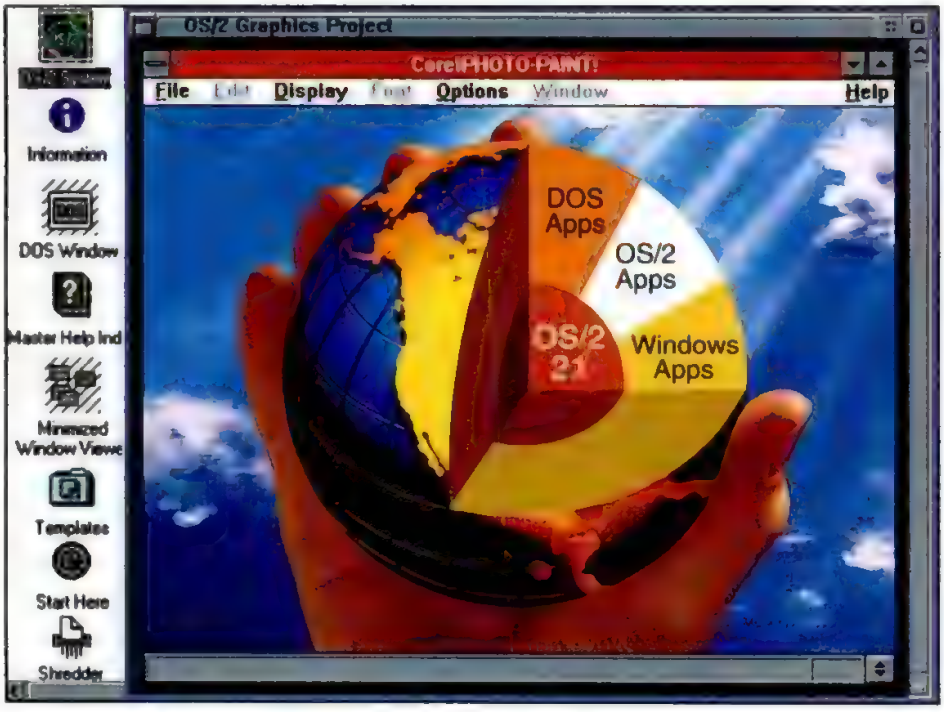

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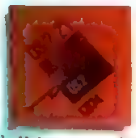

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(called a compressed volume file or CVF) in the root directory of your hard disk, and it instructs the system to treat the CVF like an added logical disk volume. Like most of the others, it swaps the drive designation of your physical hard drive (usually C:) to the CVF, assigning the original drive a new designation (in Microsoft's case, typically H:), so that you do not have to rewrite the path statement to every file and application on your disk. In fact, Microsoft licensed its basic compression technology from Vertisoft Systems, maker of DoubleDisk GOLD; it is nothing new.

What *is* new and different about DoubleSpace is that, through Microsoft-engineered integration with the operating system, the driver is able to load *before* the normal system-configuration files (CONFIG.SYS and AUTOEXEC .BAT) are processed. This eliminates "pilot" errors, where an install program (or a human being) alters or overwrites a statement in AUTOEXEC.BAT or CONFIG.SYS and makes the entire CVF disappear. This tight integration with the operating system is a major innovation in data safety that Microsoft was uniquely positioned to implement.

NUTS AND BOLTS

In PC Labs' tests, DoubleSpace was a middling performer. During the installation/compression phase, it was slower than XtraDrive 3.0 (which doesn't defragment the disk before compression) but considerably faster than Stacker 3.1. The compression ratio DoubleSpace achieved was average, bested in most file-type categories by Stacker 3.1, which managed to wring compression ratios about 10 percent greater than those achieved by DoubleSpace across the file types we tested.

When running applications, we found that all the file compression programs increased system performance slightly. Running applications from a compressed drive tends to be faster than from an uncompressed drive, because DOS reads the compressed data into memory in 8K clusters, instead of DOS's 1K or 2K size. Disk reads are faster too: Since data is stored in less space, the disk heads have correspondingly less distance to travel to find the next sector. Disk writes, on the other hand, tend to slow performance, because files must be tokenized and compressed before being written to disk.

WEAK LINK

DoubleSpace's maintenance and optimization tools are its weakness. To begin with, the Windows/DOS compression integration is minimal. You cannot install or run DoubleSpace from Windows. A single meager utility available through the Tools menu in the Windows File Manager provides a rough graphical indication of the proportion of free-to-filled disk space, and it gives compression ratios for a selected file or files. Unfortunately, if you install DOS 6 before Windows, this Tools-menu selection will not be installed in File Manager; you will have to rerun DOS 6 Setup, using the /E switch to add it.

DoubleSpace includes some DOS tools, enabled through the DOS command line or a menu by typing DBLSPACE. More numerous than the Windows tools, these are also somewhat minimal: They provide size and compression-ratio information, compress a floppy disk, perform light maintenance chores like growing, shrinking, or defragging the CVF, and offer a few other tasks. Microsoft's gravest omission is of an uninstall feature that would guide you through decompressing the files and restoring your drive to its original condition. No one but Microsoft could get away with this omission.

THE SQUEEZE PARADE

DoubleSpace has a number of other shortcomings. It supports compressed floppy disks only on other DOS 6 PCs running DoubleSpace. Further, DoubleSpace maxes out at only 256MB of physical disk space (512 compressed), while Stacker can compress up to 1GB (2GB compressed) per drive. Finally, DoubleSpace has few optimization tools.

With so many DOS 6 users compressing (Microsoft says 62 percent), it's no surprise that there have been reports of data loss. While we have been unable to duplicate single failure of DoubleSpace with regularity, it would be prudent for Microsoft to consider taking better precautions.

H I G H L I G H T S

Data Compression

DISK COMPRESSION works through a memory-resident device that shrinks and expands files as they are written and read from disk. Each package relies on some form of the "lossless" Lempel-Ziv algorithm.

SUPERSTOR PRO and Doubledisk GOLD use a "first-generation" compression technique that loads the compression driver and swaps the host and compressed drives with statements in CONFIG.SYS or AUTOEXEC.BAT. Microsoft DoubleSpace and Stacker 3.1 load the driver *before* the normal system-configuration files are processed. XtraDrive is unique in that it replaces the system BIOS.

STACKER 3.1 HAD THE GREATEST compression ratios and XtraDrive had the speediest performance. Most of the compression products did not affect application performance; some even enhanced it.

CAUTION IS ADVISED since installing disk compression software virtually rewrites all the files on your disk. If you use a disk caching program like SmartDrive, make sure that all the delayed writes (write-behind caching) have been written to disk before turning your machine off. Since DOS 6 installs with write-behind caching set to on, you can turn it off manually by editing your the SmartDrive statement in AUTOEXEC.BAT to read: C:\DOS\SMARTDRV.EXE H (where H is the host drive).

BEFORE COMPRESSING, clean and back up your hard disk. Disable all memory-resident programs, run CHKDSK to fix cross-linked files, and run a defragmentation program.

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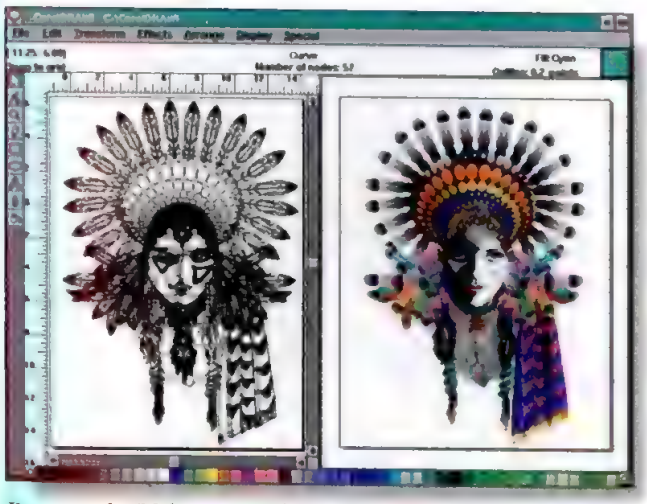

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Performance Tests: On-the-Fly Compression

PC Magazine Labs ran a series of tests on each of the applications to see how on-the-fly compression affects overall system performance. We also looked at the time required to create an uncompressed drive from one with existing data, and at how well each program compressed data.

What the Numbers Mean

Although the inclusion of disk compression in MS-DOS 6.0 will mean that more drives are likely to ship precompressed, most users are likely to install on-the-fly (OTF) compression programs on disks that already contain data. Therefore we first tested how much time was needed to compress a 60MB partition that contained approximately 50MB of fragmented files.

IIT's XtraDrive was by far the fastest program when converting a fragmented, uncompressed drive. The reason? XtraDrive was the only program that did not do any sort of defragmenting during installation. Since XtraDrive performs file compression by providing an alternative filing system rather than storing files in a container, the company does not feel that defragmentation is necessary. Hence IIT's defragmentation program, XDEFRAG, is extremely slow; the user is better off using a different defragmentation tool, such as DOS 6.0's DEFRAG.

FAST SQUEEZE All of the programs were reasonably fast on compression. The slowest, AddStor's SuperStor PRO, compressed the 50MB of data in less than 19 minutes—not bad for a one-time task. On older, slower systems where OTF compression is more likely to be used, speed is likely to decrease proportionately and will become more of an issue.

SLOW DRIVE Hard disks tend to be among the slowest subsystems on a computer. Therefore, OTF compression may actually speed up a system, since fewer disk reads and writes are required. In our Windows Applications test suite, all of the configurations with compressed disks completed the tests in about the same time as the uncompressed disk configuration. Only XtraDrive was markedly slower: It took more than 10 percent longer than the uncompressed disk and nearly 15 percent longer than SuperStor PRO, the fastest program.

AN EVEN TRADE? Each program must provide a tradeoff between compression level and performance. Given unlimited time, it's likely that all of these programs would be able to compress files to an even greater degree than our testing shows. However, all the programs cut off compression before a noticeable performance degradation occurs.

Compression levels are usually reported as a ratio—the amount of disk space used by the original file compared with the amount of disk space used by the compressed file. For example, a 24K file that compresses to 8K would have a compression ratio of 3:1. Therefore, the higher the ratio, the more disk space is saved.

Among the programs tested, Stacker—the second-fastest program on the Windows Applications tests—consistently provided the highest compression ratios. And remember, on a 100MB hard disk, each 0.1 of compression ratio represents 10MB of disk space. Thus, slight differences in compression ratios can make a big difference in the amount of data that can be stored.

How We Tested

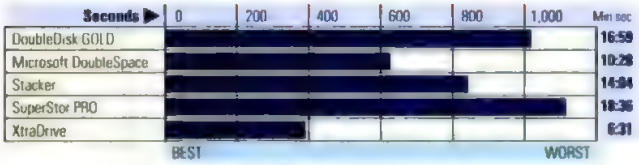
We performed all tests on identically configured Compaq Deskpro 486/33Ms with 8MB RAM and 340MB hard disks.

For **Compression Speed,** we measure the amount of time it takes each program to compress a 60MB partition containing approximately 50MB of fragmented data. The data includes multiple installations of Microsoft Word for Windows, which provides a realistic mix of program and data files.

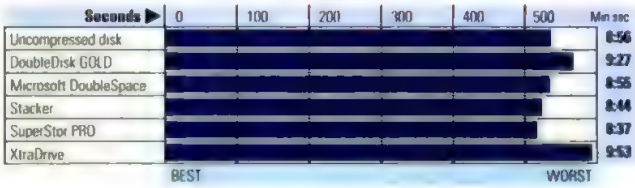
The **Windows Applications** test suite runs an automated series of real-world procedures in four Windows applications: Lotus's Ami Pro (word processing), Corel's CorelDRAW (graphics), Microsoft Excel (spreadsheet), and Software Publishing Corp.'s Superbase (database).

For **Compression Ratios,** a group of data files of each specified type (see the table "Compression Ratios") is repeatedly copied to a compressed 20MB partition until DOS reports that it cannot store any more data. We calculate the compression ratio by dividing the total size of the files copied by the size of the container file.

Compression Speed



Windows Applications



Compression Ratios

	Programs (.EXE, .COM)	Text (.TXT)	Word processing (.DOC, .SAM, .WP5)	Raster graphics (.PCS, .BMP, .WPG)	Vector graphics (.CGM, .GEM, .WMF, .CDR)	Compressed (.ZIP)	Spreadsheet (.WK1, .XLS)	Database (.DBF)
DoubleDisk GOLD	1.6:1	1.5:1	1.9:1	2.7:1	1.8:1	1.0:1	2.1:1	3.5:1
Microsoft DoubleSpace	1.6:1	1.5:1	1.9:1	2.7:1	1.8:1	1.0:1	2.1:1	3.6:1
Stacker	1.7:1	1.9:1	2.1:1	3.0:1	1.8:1	0.9:1	2.3:1	3.5:1
SuperStor PRO	1.6:1	1.5:1	1.8:1	2.3:1	1.7:1	1.0:1	2.1:1	3.3:1
XtraDrive	1.7:1	1.6:1	2.0:1	2.8:1	1.7:1	0.9:1	2.1:1	3.6:1

These ratios compare the size of the original file with the size of the compressed files. Larger ratios represent better compression.

Mere words can't DeScribe it.

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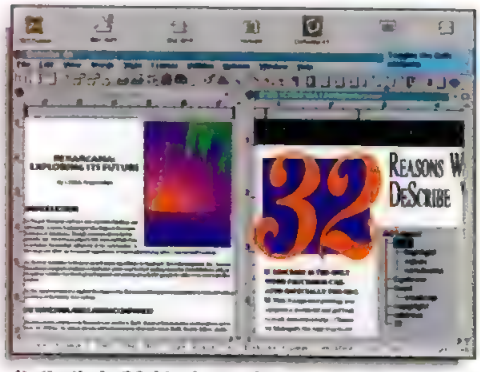
PC Magazine had these words to say about DeScribe® Word Processor 4.0 for OS/2®—"It...performs amazing acrobatic feats of editing and display that leave rival programs gasping in envy."



DeScribe's 32-bit design lets you get every last bit of power from OS/2.

PC Week wasn't exactly at a loss for words either. They said DeScribe "sets the standard for OS/2 applications by taking excellent advantage of the operating system's advanced features."

DeScribe is the only word processor designed from the ground up for OS/2. That's why it thrives in the Workplace Shell.™ Print an unopened document, copy it to the clipboard or paste it directly into another document simply by dragging the DeScribe document object and dropping it on the appropriate custom tool icon. DeScribe's 32-bit architecture is designed to give it a performance advantage over 16-bit Windows™ programs. And with OS/2's multithreading and true pre-emptive multitasking, DeScribe can perform several tasks simultaneously while operations in other applications are underway.

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For example, they might disable write-behind caching as a default condition (see the sidebar "Disk Cache: Performance vs. Safety"), do an initial scan of the media for defects, and institute some built-in integrity-checking measures.

▶ FACT FILE

Microsoft DoubleSpace
Microsoft Corp., One Microsoft Way, Redmond, WA 98052-6399; 800-426-9400; fax, 206-936-7329.
List price: *$129.*
Requires: *640K RAM, 5MB free hard disk space, (6.5MB for Windows users).*
Circle 441 on reader service card

Vertisoft Systems Inc.

DoubleDisk GOLD

BY CHRISTOPHER BARR

Vertisoft Systems' DoubleDisk GOLD 6.0 may be more important as interesting history than as a product for today's market. Released in 1989, DoubleDisk was the first real-time compression product, and it was DoubleDisk's compression technology that Microsoft licensed for DOS 6's DoubleSpace. But DoubleDisk 6.0 seems permanently relegated to working with DOS 5.0 and earlier versions, as Vertisoft does not plan to retrofit DoubleDisk with the Microsoft Real-Time Compression Interface (MRCI) that Microsoft hopes will become a standard.

DoubleDisk (along with SuperStor PRO) clearly comes from "Before DOS 6" in the way it installs and addresses a compressed volume file (CVF). (See the DoubleSpace review the precedes this for a discussion of drive "swapping" and other details of real-time compression technology.)

This drive swapping technique can create problems, for it requires the system (and user) to keep duplicate, synchronized copies of AUTOEXEC.BAT and CONFIG.SYS on both the host and CVF. When programs that edit your startup files don't modify the correct version, or delete or overwrite a critical statement, your data can become inaccessible. DOS 6 avoids this by loading DoubleSpace before CONFIG.SYS or AUTOEXEC.BAT are processed. As a result, only one copy of each is required by DOS 6, pretty much eliminating the likelihood of data loss from this cause.

NO FRILLS

DoubleDisk has no Windows interface. You can't install it under Windows, nor should you attempt to run its utilities under Windows. When we attempted it, we experienced General Protection Fault errors. Still, DoubleDisk is Windows-aware, at least to the degree that, during installation, it left our Windows permanent swap file untouched on the uncompressed host drive.

DoubleDisk's DOS interface is basic and functional. With maintenance utilities provided, we were able to grow and shrink compressed drives, create additional CVFs (including floppy disks), and handle optimization tasks. DoubleDisk also provides a defragger, Speedbak, and a recompression utility that frees up an extra 10 to 15 percent of space on the disk.

The procedure for compressing floppy disks is clumsy and inconvenient: Once you've created a compressed disk, before you can read or write to it, you must "mount" (activate) it. But DoubleDisk only works with free disk space; you can't compress preexisting files. To access a compressed floppy under Windows, you have to mount it first while in DOS. And floppies compressed under DoubleDisk are read only by PCs running DoubleDisk.

Stacker provides more configuration and safety options than all the other compression-software products combined.

DoubleDisk's uninstall feature and ease of installation redeem it to a degree. But since it uses the pre-DOS 6 method of swapping drives and has virtually no Windows interface, we think it is best left to history; you should look elsewhere for compression software.

▶ FACT FILE

DoubleDisk GOLD, Version 6.0
Vertisoft Systems Inc.,
600 Montgomery Street, 4th Floor, San Francisco, CA 94111; 415-956-5999; fax, 415-956-5355.
List price: *$49.95.*
Circle 442 on reader service card

Stac Electronics

Stacker 3.1 for Windows & DOS

BY CHRISTOPHER BARR

Despite a strong challenge from Microsoft, Stac Electronics remains at the head of the compression-product pack with the release of Stacker 3.1 for Windows & DOS. Of all the packages we reviewed for this roundup, Stacker offers the best combination of features and performance.

Stacker incorporates a method of preloading the compression driver similar to DOS 6's, and it provides more configuration and safety options than all the other products combined. Disk compression is risky business, and Stacker does an admirable job of minimizing the risks with its excellent suite of tools.

The Stacker box ($149 list) contains two sets of disks, one for DOS 6 users and one for users of all other DOS versions. We tested the DOS 6 version. (With other versions of DOS, Stacker follows the more traditional approach of loading the compression driver and swapping the host and compressed drives with statements in CONFIG.SYS.)

During installation, Stacker substitutes its own version of DBLSPACE.BIN for DOS 6's; this then loads the Stacker compression driver before CONFIG.SYS and AUTOEXEC.BAT are processed. Stacker thus gains the safety advantage enjoyed by DOS 6 and Xtra-Drive 3.0: Errant installation programs (or users) cannot edit a configuration file and render data inaccessible. Moreover, Stacker keeps a separate backup of the FAT (file allocation table) for the CVF (compressed volume file) on the host drive as added insurance.

STACKED

Stacker comes with a slew of utilities that can be run from the command line, a menu under DOS, or a Program Manager

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Tools for the Big Squeeze

by Christopher Barr

DOS 6's DoubleSpace comes with few frills, but there are two MRCI-compliant programs that will ease management of your compressed DoubleSpace disks. Addstor's $99 DoubleTools for DoubleSpace and Vertisoft Systems' $49.95 SpaceManager add a Windows interface DoubleSpace lacks, as well as additional utilities to enhance DoubleSpace's efficiency.

SpaceManager, with both a DOS and Windows interface, provides nominally more compression information than the File Manager under Windows. SpaceManager's strength is a 4K TSR that lets you set specific compression levels for classes of files to achieve a tighter compression ratio. Alas, it works only with files you compress after making the new settings; it won't recompress existing files.

By loading another 13K worth of TSRs into memory at boot-up, SpaceManager can mount a compressed floppy disk and accurately predict free space available. When using a compressed disk on another system running Windows, you'll still have to unload Windows in order to run a utility that lets you access the compressed files on the floppy disk.

DoubleTools, from the makers of SuperStor PRO (reviewed here), is a vastly more ambitious effort than SpaceManager. Combining maintenance tools that work on compressed DoubleSpace disks with file utilities, DoubleTools provides a complete Windows view of your DoubleSpace-compressed disk.

Examining an early beta copy of DoubleTools, we were impressed by the information displayed in the Compression Central window. Here, you get graphical views of disk usage and fragmentation, and through it you can launch utilities to grow and shrink or optimize the compressed drive. Also, the disk-balancer option accurately represents actual free space on the compressed disk.

DoubleTools' File Director feature compresses floppy disks and other external media and makes them readable on non-DoubleSpace systems. A sort of mini-File Manager, it lets you copy files to compressed media and span more than one floppy disk with a file. File Director also has file viewers. □

▶ FACT FILE

DoubleTools for DoubleSpace
Addstor Inc., 1040 Marsh Rd., Menlo Park, CA 94025; 800-732-3133, 415-688-0470.
List price: *$99.*
Requires: *DOS 6, Windows 3.1.*
Circle 545 on reader service card

▶ FACT FILE

SpaceManager
Vertisoft Systems Inc., 600 Montgomery St., San Francisco, CA 94111; 415-956-5999; fax, 415-956-5355.
List price: *$49.95 ($89.95 after November 15, 1993).*
Requires: *DOS 6, DoubleSpace.*
Circle 546 on reader service card

selection under Windows. These utilities include a number of optimization tools, which provide three levels of defragmentation. There's also a tune-up utility to select a balance between the best compression ratio and the fastest read/write speed. Stacker 3.1 also provides file-integrity checks and numerous compression statistics.

Stacker performed admirably on PC Magazine Labs' speed and compression-ratio tests, landing in the upper range among all products tested. While we couldn't find any replicable failures during testing of the compression products, we did find a number of intermittent problems with all of them.

Stacker's built-in safety features become vitally important when things go wrong. At boot-up, Stacker looks for damaged compressed files and will write-protect the disk. If the program discovers any errors, it will prompt you to launch a recovery utility that repairs any problems. Stacker 3.1 also includes an uninstall feature called "Unstack."

WINDOWS-SAVVY

We found Stacker's Windows utilities to be a step above those of the competition. The Stackometer provides a graphical view of your compression ratio and indicates how much disk space is available and what the fragmentation level is. If you need to optimize the disk or run the tuner, however, Stacker will shell out to DOS in order to perform the work.

When you install Stacker under Windows, it adds extensions to the File Manager to provide additional file and drive statistics. You can get information on a group of files, an entire disk, or an individual file.

Since it competes directly with Microsoft's DoubleSpace, Stacker has a utility that automatically converts DoubleSpace drives to Stacker drives. (Microsoft has a Stacker-to-DoubleSpace converter available as an option to DOS 6.) The DoubleSpace-to-Stacker conversion takes only a few minutes because it attaches a Stacker header to the DoubleSpace file format. Although the Stacker manual says you can use the DOS-turned-Stacker hybrid file format as is, we encountered some incompatibility with Norton Disk Doctor (in The Norton Utilities, Version 7.0), which is confused by the file format and may damage the file if it tries to fix it. But running Stacker's Restack on the hybrid file will bring it into full compliance with both Stacker and Norton Disk Doctor. A fix is currently available from Symantec.

If you compare features, Stacker has it all over the other products in this roundup, although XtraDrive does have a larger disk capacity. Keep in mind, however, that Stacker is by no means perfect. Its floppy disk capabilities aren't any better than those of the other programs: To access a compressed floppy disk on another ma-

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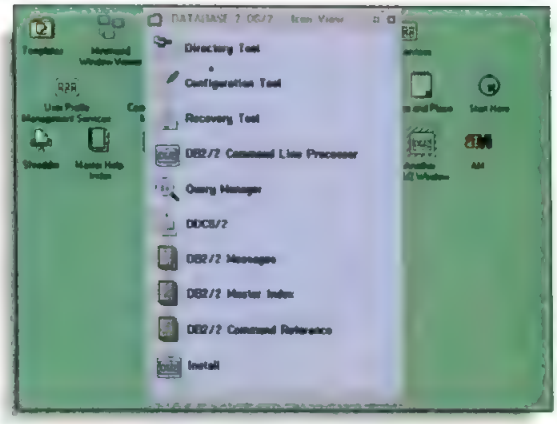

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chine under Windows, you still have to load the compression driver in DOS.

Still, Stacker is head and shoulders above all the other compression products—including DoubleSpace. If you want the safest and most reliable disk compression, run, don't walk, to Stacker.

▶ FACT FILE

EDITORS' CHOICE Stacker 3.1 for Windows & DOS

Stac Electronics, 5993 Avenida Encinas, Carlsbad, CA 92008; 800-522-7822.
List price: *$149.*
Circle 443 on reader service card

Addstor Inc.

SuperStor PRO

BY CHRISTOPER BARR

SuperStor PRO ($149.95 list) has been the perennial runner-up to Stacker, but it falls even farther behind with the release of DOS 6. While SuperStor PRO is a credible product, its driver can't be preloaded like DoubleSpace, Stacker, or even XtraDrive drives. This makes it susceptible to the same vagaries that affect all other "first generation" compression programs, which must swap drives in CONFIG.SYS or AUTOEXEC.BAT (see the DoubleSpace review for a discussion of drive swapping and other details on real-time compression technology).

NOT ALWAYS SUPER

SuperStor PRO's installation process is less automated and less secure than its peers'. Advanced users may prefer the hands-on method for SuperStor PRO, which requires you to make numerous decisions during installation and use. Most novices, however, will probably be put off by it. Worse, the recovery procedures that SuperStor PRO refers you to were missing in the two copies of the manual we examined.

Advanced users may prefer SuperStor PRO's hands-on installation method; novices, however, will probably be put off by it.

Like the other packages we saw, SuperStor PRO comes with a number of menu-driven utilities that help you manage your compressed disk. With them, you can expand or shrink the compressed volume, create compressed floppy disks and other removable media, and obtain compression statistics. An uninstall utility is available through the DOS prompt to decompress files and copy them to a DOS disk.

If you have Windows on your hard disk when you first install SuperStor PRO (under DOS only), it will add a new group to the File Manager. Most of the informational utilities available under DOS are then accessible from within Windows. Of course, the utilities that need to access the CVF (compressed volume file) directly, such as disk analysis and disk tune-up, are available only under DOS.

But we have to question the robustness of SuperStor PRO's disk utilities when it comes to fixing a problem. We encountered a number of unrecoverable errors when we turned the power off while running SuperStor PRO's recompress utility. The product's analysis utilities were unable to repair the damage, and we lost data.

SuperStor PRO has a scheme to make compressed floppy disks readable by systems not running SuperStor PRO. When an executable driver called Universal Data Exchange is added to the floppy disk, other systems can read and write to the disk.

Addstor seems to have conceded the compression market to Microsoft, directing its efforts instead toward a utility kit called DoubleTools for DoubleSpace, which uses the Microsoft compression standard. With SuperStor PRO's weaknesses weighed against DoubleSpace's strengths and Stacker's consistency, SuperStor PRO's slow fade to the background shouldn't upset many.

▶ FACT FILE

SuperStor PRO
AddStor Inc.; 1040 Marsh Rd., Menlo Park, CA 94025; 800-732-3133, 415-688-0470; fax, 415-688-0466.
List price: *$149.95.*
Requires: *512K RAM (640K recommended), 3.5MB hard disk space, DOS 3.2 or later or DR DOS 5.0 or later.*
Circle 444 on reader service card

Integrated Information Technology Inc.

XtraDrive

BY CHRISTOPHER BARR

Integrated Information Technology's $79.95 XtraDrive, Version 3.0, is the most unusual compression program here. XtraDrive installs its own BIOS that works in conjunction with the XtraDrive compression driver and interrupt handler. As calls go to DOS's INT13, XtraDrive intercepts the calls, compresses the data, and saves the files to disk.

Also, XtraDrive uniquely handles the creation and naming of the compressed volume. During installation, it replaces the DOS boot record with its own file system, completely compressing the existing disk volume. By means of a device driver, it then creates an additional disk. If you lose the device driver, you won't have access to the newly created drive (typically D:), but you can still access the files of the original drive (usually C:). Because of its unique file system, XtraDrive can compress up to a 2GB drive, providing for up to 4GB of compressed data.

An emergency disk containing the compression driver makes the additional disk reaccessible in case of mishaps. If you boot from a clean floppy disk after installing XtraDrive, you won't be able to run CHKDSK on C: because it was already made into a non-DOS partition.

Since XtraDrive uses its own BIOS, it can compress system files and the Windows permanent swap file and can thus be installed on your boot drive. You therefore don't have to swap drives as you do with DoubleDisk or SuperStor PRO. XtraDrive installs a hidden file into your root directory, but here it only stores additional FAT (file allocation table) information; the hidden file does not store compressed data.

BESIDES TECHNOLOGY

XtraDrive comes with both a command line and a menu-driven interface. A few utilities are available in both modes. While some of the switches on the com-

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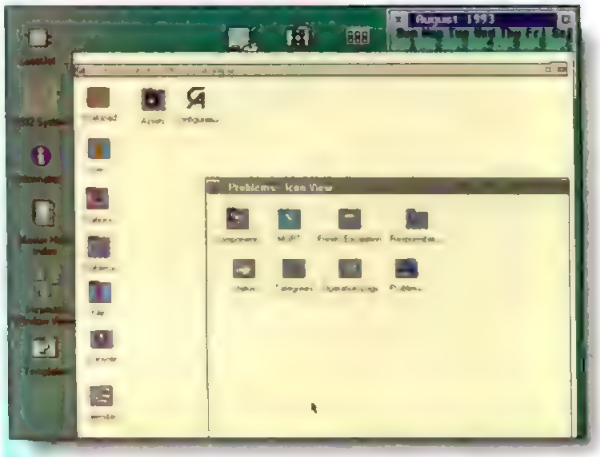

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mand line seem arcane, the menu-driven utilities are fast and easy to understand. There is no Windows interface. The menu-driven utilities are primarily informational, giving size and availability statistics. You can also check for and repair disk errors from the menu.

The utilities available via the command line include a mediocre defragger and a formatter for compressing removable media. You can't compress preexisting data on a floppy disk; any data on the disk will be destroyed by the format. The compressed floppy can then be used on non-XtraDrive systems by running a file that loads a 44K driver into memory. The floppy disk is then read/write, but there is no way to unload the driver from memory without rebooting. When we tried to access the floppy disk under Windows before loading the driver, it repeatedly crashed.

Additional command line utilities show you file-compression ratios and let you store files uncompressed. They also include a space optimizer and an uninstall utility that simply destroys the additional drive without saving its contents.

XtraDrive's differences with the other disk compression programs reveal both good and bad news. First, the bad: We discovered during testing that XtraDrive can cause system crashes when running with the default configuration of SmartDrive (DOS 6.0's disk cache module)—specifically, with write-behind caching enabled. Accordingly, we recommend XtraDrive users turn off write caching or replace SmartDrive altogether.

On the positive side, we found XtraDrive to be fairly robust. In the very unlikely event you lose or destroy the compression driver, the original drive will remain available, and the additional drive can be accessed by copying the driver from the emergency disk. But since most of the utilities and commands must be accessed from the C: prompt, we recommend XtraDrive only for users comfortable working from the command line.

▶ FACT FILE

XtraDrive, Version 3.0

Integrated Information Technology Inc., 2445 Mission College Blvd., Santa Clara, CA 95054; 800-832-0770, 408-727-1885; fax, 408-727-1290.

List price: *$79.95.*

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Memory Management

Does MemMaker Raise the Stakes?

Microsoft Corp.

Microsoft MemMaker

BY RICK AYRE

The potent combination of the improved EMM386 and the new optimization module MemMaker places DOS 6 in direct competition—for the first time—with the major memory-management-software players reviewed here. MemMaker, while no technical revelation, is a worthy contender in the ease-of-use and reliability battle among memory managers. And if you don't already own a memory manager, DOS 6's upgrade package—with the operating system as well as EMM386 and MemMaker—is clearly worth the price of admission.

Using the EMM386 included in DOS 5, you can map extended memory into unused memory regions between 640K and 1MB. Those UMBs (upper memory blocks) can be used to load TSRs and device drivers that would otherwise be loaded in the 640K area that DOS normally uses to load applications and data.

The new EMM386 scans more upper memory for unused regions. (The old EMM386 scanned C000h through DFFFh. The new EMM386 scans C600h all the way through F7FF.) As a result, where the old DOS could create a maximum of 96K of UMBs, the new EMM386 can create as much as 200K of UMBs.

Probably the most significant change to EMM386 is that it can now allocate expanded memory and extended memory dynamically—on demand—from a shared pool. You no longer have to choose between extended and expanded memory at boot-up. Also, EMM386 now acts as a Virtual Control Program Interface (VCPI) server. This means you can load programs (such as AutoCAD) that use DOS-extender technology, even if you specified NOEMS on the line you used to load EMM386.

MAKING MEMORY

Beyond finding unused UMBs and inserting the statements in AUTOEXEC.BAT and CONFIG.SYS, which plug your TSRs and device drivers into those UMBs (just like the big boys have done for quite some time), MemMaker is safe and reliable and worked without a hitch on all our testbed machines. It doesn't have all the bells and whistles of the other optimization programs—NetRoom's cloaking, QEMM-386's Stealth, or 386MAX's ROMSearch—but it's no slouch, either. You can choose to use it in batch mode, which doesn't require any user intervention, Express mode, which requires you to answer a few questions, or Custom mode, which offers advanced options. You can also specify programs to load high and choose whether or not to be aggressive in scanning for available upper memory.

Although MemMaker never reclaimed the most memory in the 640K box, it performed well in our "simple" test configurations and basically finished in a dead heat with the other reviewed products. When its Highscan feature

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(which is the default) is enabled, however, MemMaker uses what we believe to be a dangerous memory-reclaiming technique. Some ROM BIOS makers load two copies of their BIOS in upper memory. Highscan searches for a duplicate BIOS and, if it detects one, maps over it. Memory calls to the BIOS are directed to the remaining BIOS, and, as a result, 32K of memory located at F000 can be reclaimed. When it works, this technique works well. We don't recommend it, however, for those who want to put safety first.

Let's be clear. EMM386 was not the first driver to make upper memory usable, nor are any of its features unique. But what Microsoft may have seized upon is the idea that memory management is now a must for *anyone* running DOS applications, even in the Windows environment. Today, memory-management utilities need to be easy to use, compatible with other applications and drivers, and thoroughly reliable. With DOS 6's memory-management software, Microsoft seems to have accomplished at least this much.

In fact, MemMaker may well meet many users' needs. When memory demands are highest, the third-party programs are still better, but if your needs are modest, DOS 6 should be able to handle them.

Qualitas Inc.

386MAX

BY RICK AYRE

Qualitas's 386MAX was the first memory manager to reclaim DOS memory, and it remains one of the best. Qualitas has added a lot of new stuff to 386MAX, Version 7, but most of the changes are subtle rather than dramatic.

With ROMSearch, Qualitas's answer to Quarterdeck Office Systems' Stealth technique, 386MAX can map extended memory into empty spaces in the regions between 640K and 1MB, as well as map memory into some regions that your BIOS occupies. It does this by searching your system ROM BIOS after start-up for portions earmarked for some purpose but never actually used, and then mapping UMBs over them.

HIGHLIGHTS

Memory Managers

EMM386/MEMMAKER bring strong, easy-to-use memory management to every desktop running DOS 6. A technical revelation? No. But a good pick for those who don't already own one of the big three.

NEW TECHNOLOGY FROM Helix Software and Quarterdeck Office Systems is helping users squeeze more memory than ever out of the 640K box.

THE LAST TIME MOST OF US heard of "cloaking," we were watching Star Trek reruns. But what once described the Romulan's secret weapon is now NetRoom's strongest new technology. Working with Award Inc., the BIOS manufacturer, Helix has created video- and system-BIOS replacements that can be loaded mostly in extended memory. Just a small 8K pointer is left in the 640 box to point to the actual location of the BIOSes.

QEMM'S STEALTH TECHNOLOGY has always had a cool name. But now QEMM-386 has a feature called DOS-Up that can load the DOS command processor (as well as other resources, like FILES, BUFFERS, and the like) into the high memory area.

HELIX, QUALITAS, and Quarterdeck have been providing more memory to DOS sessions running under Windows by releasing memory set aside for graphics. This has always been possible, but now it's easier to do, and, in some cases, user-definable.

ExtraDOS, which reduces DOS overhead as much as 20K by allowing you to load high the DOS BUFFERS, COMMAND.COM, FCBS, FILES, LASTDRIVE, and STACKS configuration commands, has been added to Version 7 of the program.

According to Qualitas, the program is meant to address the needs of users faced with an increasing complexity of system configurations when moving from DOS to Windows. 386MAX is also intended to take advantage of some specific DOS 6 features.

For example, it will optimize MultiConfig setups (unlike DOS's own MemMaker) and will reclaim 24K that DOS 6 by default allocates to Windows (and it will dynamically allocate it to DOS or Windows as needed).

EASY DOES IT

386MAX was as fast as any product we tested. In terms of reclaiming memory, 386MAX tied QEMM-386 for second place, closely following NetRoom. It even did a slightly better job than NetRoom and QEMM-386 on all three of our test scenarios. But if easy is what you want, Qualitas's Maximize program was almost as easy to run as MemMaker. It ran without a hitch in all of our test configurations.

Windows users should appreciate the job that 386MAX does in providing Windows-specific memory management. The 386MAX MAXimize program automatically creates a program group in Windows and adds three icons: a PIF (program information file) editor and two icons for DOSMAX. One is for full-screen operation and the other defaults to a windowed session. According to Qualitas, DOSMAX provides up to 736K of DOS memory to DOS sessions under Windows by mapping memory into the regions normally reserved for graphics applications. In testing, the size of the DOSMAX DOS box was more like 680K—still quite a respectable size. Just don't try to run a DOS program that requires graphics. Also, Qualitas's PIF editor—though it has little to do with memory management—is a significant enhancement over the Windows PIF editor.

Three other new features are definitely related to memory management. They include QMT, a program that tests RAM for "flaky," or defective, memory (memory that fails intermittently). Fortunately, testing with QMT didn't find any

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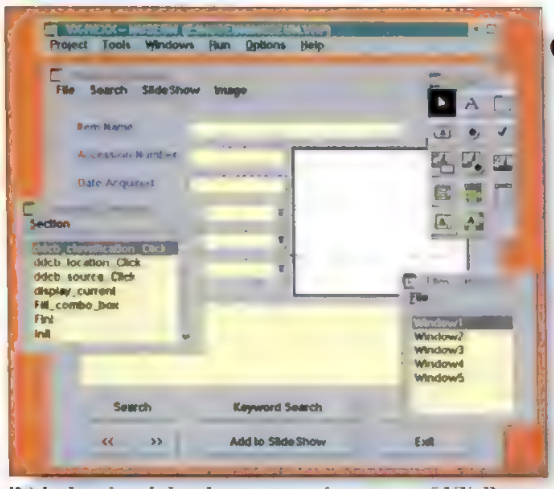

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Performance Tests: Memory Managers

What the Numbers Mean

Recovering conventional memory is the most important purpose of a memory manager. Thus, a program's performance is measured by the amount of conventional memory that can be reclaimed by relocating drivers and TSRs. Our tests report the largest executable size in conventional memory achieved by each product, the total size of the upper memory blocks (UMBs) it recovered, and the largest contiguous block of upper memory it was able to create.

No single program really stood out from the others. NetRoom, QEMM-386, and 386MAX each made available 16 to 44 percent more memory than MEMMAKER.

How We Tested

For our **Memory Management** tests, our first test-bed was a Gateway 2000 4DX2-66V with 16MB of RAM, an IDE hard disk, and an ATI Graphics Ultra Pro (a VESA VL-Bus video card). The second configuration added a SCSI controller, CD-ROM, and sound board. Last, we tested a Dell 325NC notebook computer with 4MB RAM, a 120MB hard disk, and a Xircom Token Ring Adapter attached to the parallel port.

We loaded our three systems without using any memory management other than HIMEM.SYS, and we measured the available conventional, upper, and extended/expanded RAM memory in each. We then installed each of our memory managers, using the existing CONFIG.SYS and AUTOEXEC.BAT files, the product's automatic install routine, and, wherever possible, its default options.

We initially tried the least aggressive method of installation: NetRoom without Cloaking, QEMM-386 without Stealth. Then, if any drivers or TSRs remained low, we proceeded with the more aggressive setups. We continued with additional options until the memory manger was unable to gain further memory without customized tweaking.

Setup 1: 4DX2-66 Test Bed

Hardware: Gateway 2000 4DX2-66, 16MB RAM, 340MB Western Digital Caviar 2340 hard drive, ATI Ultra Pro VL-Bus video card (1MB VRAM) Device driver or TSR

Kilobytes	Size of device driver or TSR
SETVER.EXE	1.0
HIMEM.SYS	1.0
KEYSAVE.SYS (PC-Kwik extended keyboard buffer)	0.4
DBLSPACE.SYS (DoubleSpace disk compression)	43.0
PCKRAMD SYS (PC-Kwik RAM Disk)	3.0
VSAFE.COM (Microsoft Anti-Virus)	22.0
MOUSE COM (Microsoft Mouse Driver)	17.0
SUPER.EXE (PC-Kwik Disk Cache)	69.0
PCKSCRN EXE (PC-Kwik Screen Saver)	13 0
PCKKEY.EXE (PC-Kwik keyboard buffer)	22.0
PCKSPL.EXE (PC-Kwik Print Spooler)	19.0

Memory Manager	Largest Executable	UMBs Recovered	Largest UMB
None	410	N/A	0
MEMMAKER	555	172	11
NetRoom	617	219	11
QEMM	612	210	7
386MAX	611	194	10

Setup 2: 4DX2-66 Test Bed

Hardware: Same as Setup 1 but with Trantor T128 SCSI Controller, NEC Intersect Multispin 74, Sound Blaster PRO Device driver or TSR

Kilobytes	Size of device driver or TSR
SETVER.EXE	1.0
HIMEM SYS	1.0
VSAFE.COM (Microsoft Anti-Virus)	22.0
MA120 SYS (SCSI driver)	6.0
NECCDR SYS (NEC CD-ROM driver)	10.0
MSCDEX EXE (Microsoft CD driver)	35.0
DBLSPACE.EXE (DoubleSpace disk compression)	43.0
SMARTDRV EXE (Microsoft Disk Cache)	28.0
MOUSE.COM (Microsoft Mouse Driver)	17.0

Memory Manager	Largest Executable	UMBs Recovered	Largest UMB
None	458	N/A	0
MEMMAKER	568	179	55
NetRoom	616	270	49
QEMM	610	210	56
386MAX	611	220	39

Setup 3: 386/25 Notebook

Hardware: Dell 325NC notebook (4MB RAM, 120MB Hard Drive), Xircom Token Ring Adapter Device driver or TSR

Kilobytes	Size of device driver or TSR
SETVER.EXE	1.0
STACKER.SYS (Stacker compression driver)	47.0
SMARTIPX.EXE (Xircom IPX driver)	11.0
NETX.EXE (Netware driver)	48.0
NAV&.SYS (Norton Anti-Virus)	7.0
SMARTDRV.EXE (Microsoft Disk Cache)	28.0

Memory Manager	Largest Executable	UMBs Recovered	Largest UMB
None	481	N/A	0
MEMMAKER	580	135	32
NetRoom	607	25	45
QEMM	596	184	69
386MAX	617	247	40

flaky memory on our test systems. Version 7 also supports DoubleSpace, Stacker, and SuperStor compressed drives. There is also full DPMI (DOS Protected-Mode Interface) support and stack overflow protection.

386MAX has the right combination of power and ease of use for those who don't necessarily want to understand how memory management works, but do want the benefits.

▶ **FACT FILE**

386MAX, Version 7

Qualitas Inc., 7101 Wisconsin Ave., #1386, Bethasda, MD 20814; 301-907-6700; fax, 301-907-0905.

List price: *$99.95.*

Requires: *1MB RAM, 1.5MB hard disk space, DOS 3.0 or later.*

Circle 446 reader service card

Helix Software Co.

NetRoom

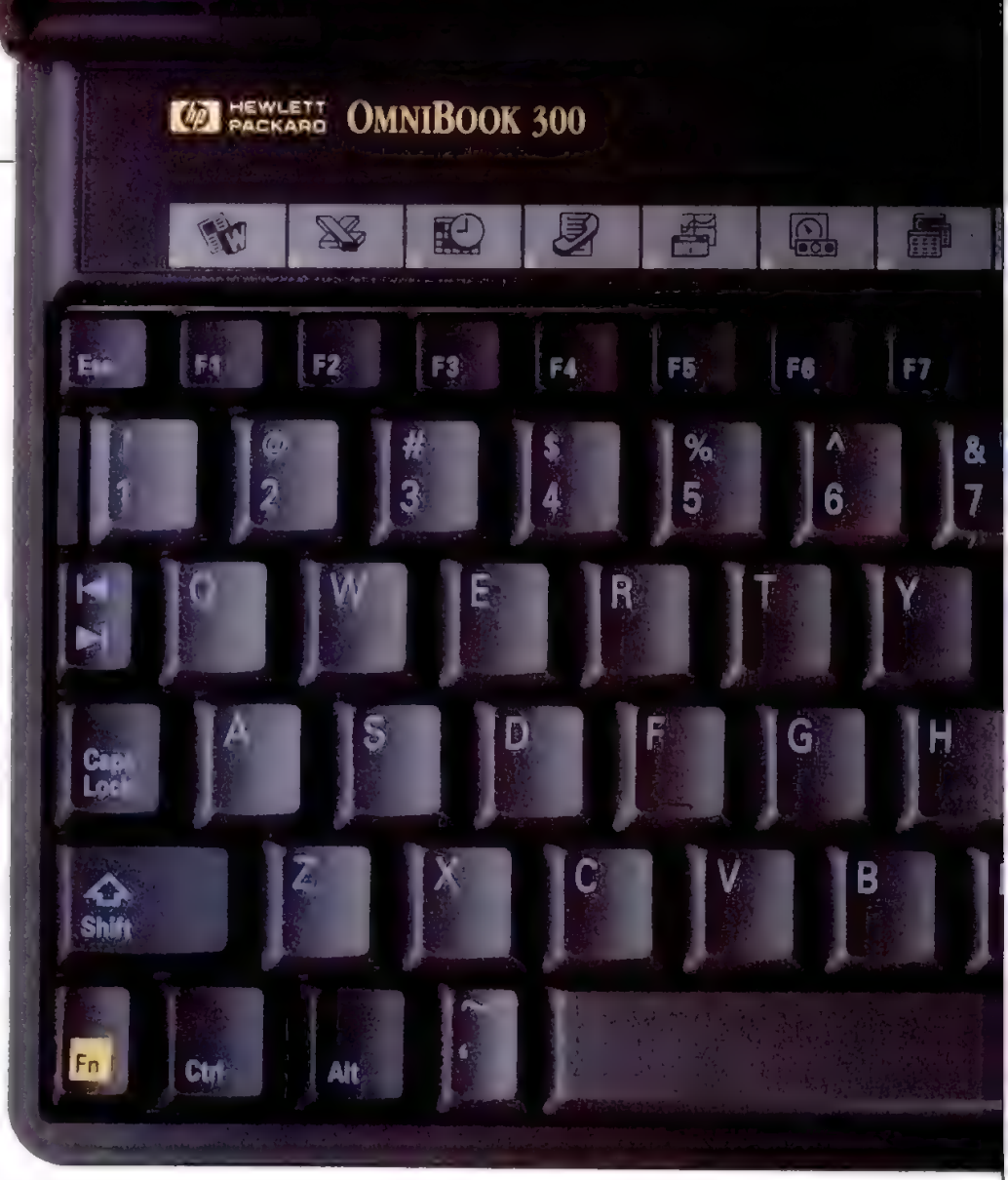
BY RICK AYRE

NetRoom, Version 3.0, from Helix Software Co. is suffering from an identity crisis. Yes, it was once primarily aimed at network users. And yes, it still comes with features especially for that crowd (such as the venerable but still useful NetSwap). But long ago, NetRoom joined the general-user fray and went head-to-head with 386MAX and QEMM-386.

NetRoom is the most significantly improved memory-management product in this roundup and the only one that introduces new technology to the pursuit of more memory and better performance. Helix calls the new technology "cloaking," and if you thought memory managers were already difficult to understand, you'd better sit down for this.

Helix has worked with BIOS maker

Hewlett-Packard and Microsoft are changing the way business travelers work.



***Dimensions** (closed): 1.4" high x 11.1" wide x 6.4" deep.*

***Weight:** Less than 3 pounds; flash disk model lighter.*

***Processor:** 386SXLV CPU.*

***Display:** 640- x 480-dot VGA; 9-inch LCD; 16-level gray scale.*

***Available PCMCIA Version 2.0 slots:** Flash disk model: 2 slots. Hard disk model: 1 slot.*

***RAM:** 2 MB expandable to 8 MB with optional, user-installable RAM expansion card.*

***I/O:** 115k-baud serial RS-232, serial infrared and parallel. Optional 2400-baud data; 9600-baud send/receive fax/modem.*

Actual size ▸

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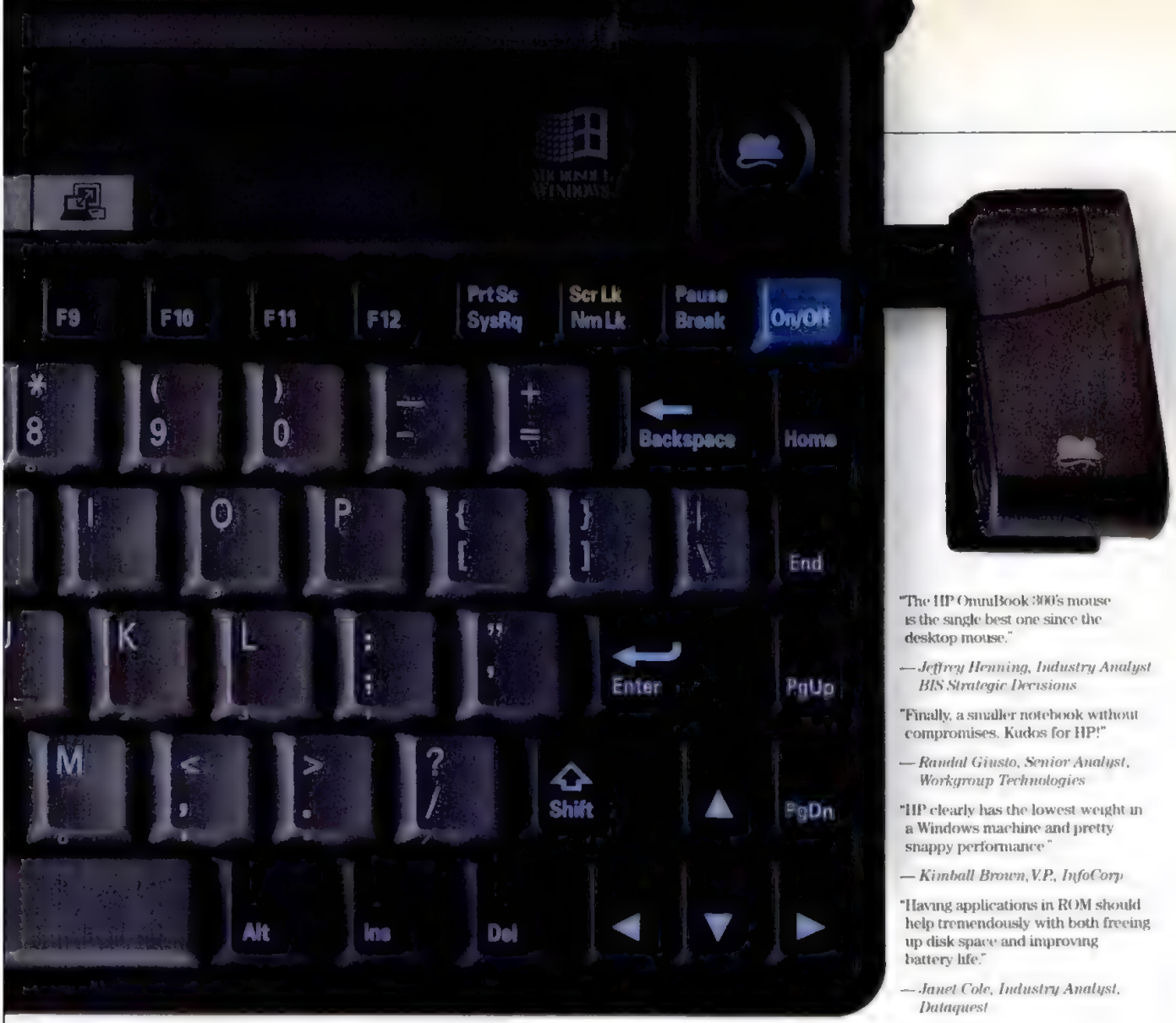

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— Jeffrey Henning, Industry Analyst BIS Strategic Decisions

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— Randal Giusto, Senior Analyst, Workgroup Technologies

"HP clearly has the lowest weight in a Windows machine and pretty snappy performance."

— Kimball Brown, V.P., InfoCorp

"Having applications in ROM should help tremendously with both freeing up disk space and improving battery life."

— Janet Cole, Industry Analyst, Dataquest

Book 300 Superportable PC.

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HEWLETT PACKARD

Award Software to create replacements for both system and video BIOS that can be loaded mostly in extended memory. Only a stub (usually occupying a few thousand bytes) is loaded in conventional memory, where it points to the location of the real BIOS. A system BIOS will use about 64K of memory; a video BIOS, 32K. If you use cloaking on both the video and system BIOS, you'll use only 8K of memory, and none of what you've used will have been upper memory.

The typical BIOS not only occupies a lot of upper-memory real estate; the parcels are large as well. This has important implications for those who need to load high large TSRs and device drivers.

In terms of reclaiming DOS memory, NetRoom led the pack during testing. It reclaimed more memory than QEMM-386 and 386MAX on two of our three test configurations and was second to 386MAX on the other. How NetRoom, or any of these programs, will perform on your computer will depend on your configuration. Our tests confirm that cloaking is an effective way to recover DOS memory. Since NetRoom tests your system for compatibility with cloaking, it is unlikely that cloaking will lead to unanticipated problems.

One limitation to cloaking is that the Award BIOS on which it's built is not compatible with all 386- and 486-based PCs. (Helix claims it works on about 95 percent of all computers. For the record, cloaking worked fine on all our testbed computers.) Also, cloaking is compatible only with Windows 3.1, not 3.0. And video cloaking only works in VGA and certain Super VGA modes (up to 800 by 600 at 256 colors). During testing, video cloaking worked on every system except our portable Compaq LTE Lite/25C when its SVGA driver was used.

An advantage of cloaking is its ability to handle interrupts, which it does without the swapping Stealth requires. It thus performs better during certain operations. For example, we discovered during testing that QEMM-386, with Stealth enabled, was significantly slower at disk reads of large files, taking up to three times as long as NetRoom.

NET PERFORMANCE

When we disabled cloaking, NetRoom worked about the same as DOS 6's MemMaker. That's not too surprising, since Helix's optimize program, Customize, served as the base for MemMaker. Just how much code is shared by MemMaker (as released in DOS 6) and Customize (as shipped with NetRoom 3.0) is something only the developers know. Basically, if you've seen MemMaker, you've seen Customize.

Customize certainly supports more features and options than MemMaker, allowing you control over every aspect of memory management. But it looks and acts just like MemMaker. Discover, NetRoom's memory-anaylsis program, was the first to let you view *and* edit your boot files right from inside the analysis program. There is a new, improved Customize included in this version of NetRoom that sports a new look and a new easy-to-learn graphical interface.

NetRoom utilities include a screen saver, disk cache, and RAM disk. These are full 32-bit programs that take advantage of NetRoom's 32-bit BIOS

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replacement and are thus faster than comparable 16-bit programs. The disk cache itself can also be cloaked, which means it won't take up more than a smidgen of DOS memory or UMB (upper memory block) space. There is also a DOS screen accelerator and virus protection for the cloaked BIOS. By shielding the BIOS from virus infection, your system should be protected from viruses that attempt to format your hard disk or damage your FAT (file allocation table), boot sector, or partition table.

Cloaking, should you choose to use it, is an impressive way to increase available memory and improve performance, and Customize continues to set the standard for optimize programs. All in all, NetRoom showed top performance in a strong field of players. Perhaps it also deserves a new name; NetRoom isn't just for network users anymore.

▶ FACT FILE

EDITORS' CHOICE NetRoom, Version 3.0
Helix Software Co., 47-09 30th St., Long Island City, N.Y. 11101; 800-451-0551, 718-392-3100; fax, 718-392-4212.
List price: *One user, $99; four users, $179.*
Requires: *1MB RAM, 1MB hard disk space, DOS 3.2 or later.*
Circle 447 on reader service card

Quarterdeck Office Systems Inc.

QEMM-386

BY AMARENDRA SINGH

Quarterdeck Office Systems is the perennial leader in memory-management market share. With QEMM-386, Version 7, Quarterdeck is fighting for every byte of memory in order to stay ahead of a field of tough competitors that now includes DOS 6's MemMaker. While QEMM-386, Version 7, doesn't introduce any dramatic new features, it does raise to new levels the art of squeezing every possible particle of memory from DOS—and of using that memory effectively.

QEMM-386 is now a full 32-bit protected-mode program that comes optimized for the Intel Pentium processor. New features include an install program that can automatically modify CONFIG.SYS and AUTOEXEC.BAT to optimize memory usage, support for multiple configuration files, full DPMI support, and a feature called DOS-Up that can load the DOS command processor and other resources, such as FILES and BUFFERS, into the high memory area (HMA). Stealth, QEMM-386's aggressive maximizing technology, includes a new DOS 6–specific feature that uses the EMS page frame to manage DOS 6's DoubleSpace driver. Manifest, QEMM-386's diagnostic and management facility, remains as good as many of the commercially available diagnostic programs we've seen. (See "Taming your IRQs," *PC Magazine*, July 1993.)

Q-COOL

Quarterdeck's Stealth uses a technique for upper memory block (UMB) recovery analogous to swapping paged memory through the EMS page frame. Stealth remains a potent memory management feature: Our testing demonstrated that QEMM is the best—or close to the best—

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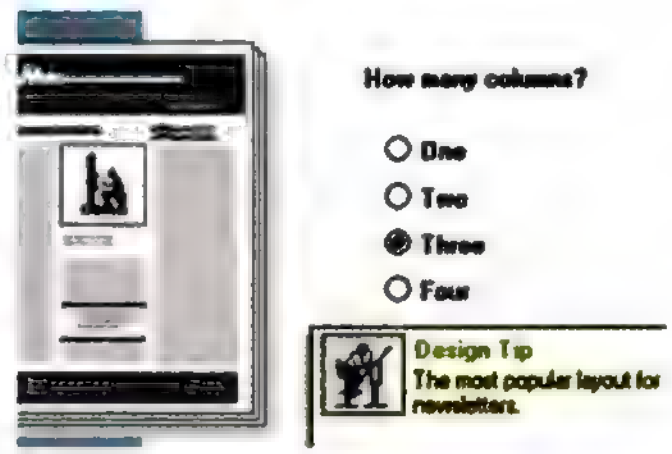

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Disk Cache: *Performance vs. Safety*

by Rick Ayre

Caching—storing data in a live memory buffer for quick access—has become a serious art form.

A traditional disk cache, operating on the theory that you tend to use the same data over and over when you work, stashes your recent disk reads in a buffer. The next time the system needs that information, it looks first in the cache; if the data is there, you've achieved something pretty close to instant access. If not, it reverts to the relatively slow process of reading data from the hard disk.

Microsoft recently took the concept of caching one step further by introducing "write-behind" caching. With write-behind caching, the system delays the "write to disk" process, storing the data in a buffer until it can execute the write without interfering with another processing task—until, that is, the system is idle. Write-behind caching was added to the SmartDrive disk cache version that shipped with Windows 3.1.

The introduction of write-back caching raised some concerns about data safety. Lately, the level of concern has risen sharply, partly in direct response to DOS 6 and its DoubleSpace utility. The combination of DoubleSpace and write-behind caching appears to have serious potential for problems.

The tricky part about write-behind caching is making sure the system always empties the cache buffers and that all your data actually gets written to disk. Partially saved data is useless; partially written files can confuse an operating system. Write-caching programs are usually smart enough to avoid the situation where the cache is not properly flushed. They can, for instance, trap the Ctrl-Alt-Del key combination, flush the buffers, and then complete the reboot.

Sometimes, however, even a smart disk cache isn't enough to prevent damage. Have you ever had a program suddenly lock up on you? If you must use the reset button or turn the system off and on when you're using a write-behind cache, you are at risk. At best, you could be fine; but at worst, you could lose a file, a directory, or more.

The introduction of write-back caching raised some concerns about data safety. Lately, that concern has risen sharply.

HOW SAFE IS SAFE?

We looked at the current versions of three popular disk cache programs: SmartDrive from Microsoft, HyperDisk Speed from HyperWare, and Super PC-Kwik from PC-Kwik Corp. We discovered that there are really two write-caching safety issues. The first is the loaded-buffer problem described above; the second is the queuing scheme the cache uses to write your data to disk.

All three programs offer write caching as an option. Write caching under SmartDrive and HyperDisk uses the "elevator seeking" algorithm to queue the writes. When a program writes cached (buffered) information to disk, it can either write the data in the order received or drop the data on the correct location on the disk when the right sectors happen to be passing by the proper cylinders. The second method is elevator seeking.

The elevator-seeking technique actually increases the likelihood that you'll encounter problems because a long time may elapse before the read/write head happens to pass over the storage location of any given piece of data. In other words, data may be held in the cache significantly longer with elevator seeking than with in-order writing.

To test this hypothesis, we used a program (developed with the help of Bruce Schafer at PC-Kwik) that displays a visual warning of "at-risk" times. Sure enough, when we powered down the system during those at-risk times, incomplete files resulted. Write caching clearly leaves users vulnerable, and elevator seeking dramatically increases the dura-

---

at creating UMB space (depending on the specific test). However, our performance tests indicated that Stealth users pay a performance penalty when reading large files from disk—a penalty that increases with the size of the file. We looked at the disk performance of all four memory managers using PC Magazine Labs' Hardware Benchmark Tests, Release 7.0. Disk access under QEMM-386—with Stealth enabled—took as much as three times as long as the fastest performer, NetRoom. 386MAX was not as fast as NetRoom, but was much faster than QEMM-386. It's certainly hard to imagine a situation where disk performance does not matter, but as with the question "How much upper memory is enough?" individual users will have their own set of priorities.

DOS SWITCH

With DOS-Up, parts of the DOS kernel and various other DOS resources can be loaded into the HMA. DOS-Up does this by loading into conventional memory a number of smaller drivers, essentially pointers, that tell the system where to find the DOS drivers that DOS-Up has already loaded high. In our tests, we were able to reclaim as much as 70K of either conventional or upper memory using this feature. DOS-Up does not require HIMEM.SYS, except on certain systems with more than 16MB of RAM. There, you still need to load HIMEM.SYS to access all your memory.

One of the nicest things about Quarterdeck's QEMM-386 is that its features

tion of that vulnerability.

We found that turning the computer off during at-risk times caused invalid entries. If we promptly ran CHKDSK /F, it fixed the problems, and the only remaining damage was one or two lost files. If we didn't run CHKDSK after every reboot and just let the damage accumulate, we eventually ended up with cross-linked files—and cross-linked directories as well.

SmartDrive and HyperDisk do not offer write caching without elevator seeking. (In HyperDisk, write-behinds are called *staged writes.*) Super PC-Kwik, however, can be configured to run with write caching but without elevator seeking (a feature it calls PowerWrite).

HyperDisk attempts to minimize the dangers of elevator seeking with its Advanced Update feature. This default option writes portions of the modified data in the cache immediately, without waiting for the system to be idle.

HOW FAST IS FAST?

An obvious solution is simply to disable write caching, but our cache performance tests showed that you'll slow down your computer significantly if you do. We tested HyperDisk, SmartDrive, and Super PC-Kwik on two computers, a 386/25 laptop with a 120MB hard disk and a 486/33 desktop with a 200MB disk, both with 8MB of RAM.

We used our Windows Applications test suite to compare read-only performance with performance using read-and-write caching on both compressed and uncompressed disks. We ran the tests three times in each configuration and averaged the timings. The following tables detail the results.

Though we did test Super PC-Kwik with and without PowerWrite, we are presenting the results with PowerWrite enabled so that you can compare Super PC-Kwik directly with SmartDrive and HyperDisk. As expected, Super PC-Kwik's performance slowed down when we turned off PowerWrite. On drives compressed with Stacker, Super PC-Kwik with PowerWrite off performed faster than either HyperDisk or SmartDrive with write caching turned off.

Windows Applications (Stacker-compressed drives)

	386/25 Test-Bed		486/33 Test-Bed	
	Write (min:sec)	No-Write (min:sec)	Write (min:sec)	No-Write (min:sec)
HyperDisk Speed	26:27	27:25	16:34	16:39
Super PC-Kwik	25:56	27:24	10:21	11:29
SmartDrive	25:43	26:52	9:36	11:15

Windows Applications (uncompressed drives)

	386/25 Test-Bed		486/33 Test-Bed	
	Write (min:sec)	No-Write (min:sec)	Write (min:sec)	No-Write (min:sec)
HyperDisk Speed	25:06	36:26	17:26	11:05
Super PC-Kwik	27:17	28:40	11:32	12:18
SmartDrive	25:35	26:31	9:40	10:52

Shorter times represent better performance

THE DOUBLESPACE QUESTION

Why does DoubleSpace find its way into a discussion of disk cache programs? Unfortunately, DoubleSpace compounds the risks inherent to the accident-prone write-behind cache system. For example, in DoubleSpace stress testing, administered by another computer publication, significant file corruption occurred, probably a result of improperly flushed cache buffers. The combination of write-behind caching and improper program termination most likely caused the problems, not DoubleSpace. But DoubleSpace didn't catch the problems once they had occurred, and damage thus accumulated.

RECOMMENDATION

There's an immutable tradeoff between speed and safety; you're more likely to be severely injured if you crash driving at 60 miles per hour than at 40 mph. The same applies to write-behind caching, especially when it's used with DoubleSpace. But we don't want to give up write caching, since it's such a tremendous performance booster. Here are a few safety tips:

- Always exit programs according to vendor instructions.
- Exit all programs and pause (5 seconds) before switching off your computer. (At press time, SmartDrive's new Version 4.2 was posted on CompuServe. It automatically flushes the write-behind cache after you exit a DOS application but before you return to the DOS prompt.)
- Check for problems on a regular basis; put the CHKDSK /F command in your AUTOEXEC.BAT file. □

are easy to use, regardless of their technical complexity. The default install, the straightforward Optimize program, and the advanced Stealth features are all manageable. The on-line help is, in fact, helpful and, to Quarterdeck's credit, the manual is now among the best that this kind of program has to offer.

While QEMM-386, Version 7, doesn't contain any technical leaps as dramatic as NetRoom's Cloaking, it nonetheless provides many important enhancements. QEMM-386's overall technical excellence and memory-reclaiming prowess are sufficient to keep it firmly in the ranks of the top three.

HOLD THE PRESSES

As we neared press time, well after we completed testing, reports of incompatibilities between some system configurations and QEMM-386, Version 7.0, surfaced. Quarterdeck confirmed that there had been problems when DOS 5, SmartDrive, and Stacker 3.0 were used together with QEMM-386. Quarterdeck responded in rapid fashion with version 7.01. In fact 7.0 is no longer for sale; for those of you who already purchased it, a patch is available on CompuServe.

▶ FACT FILE

QEMM-386, Version 7
Quarterdeck Office Systems Inc., 150 Pico Blvd., Santa Monica, CA 90405; 310-392-9851; fax, 310-314-3219.
List price: *$99.95*
Requires: *1MB RAM, 1.5MB hard disk space, DOS 3.0 or later.*
Circle 448 on reader service card

Backup & Restore

We All Need It, but Will These Do It?

Microsoft Corp.

Microsoft Backup

BY EDWARD MENDELSON

In the bad old days of DOS 2.0 through 5.0, the only backup utilities that came with the operating system were a sorry pair of command-line programs called BACKUP and RESTORE, which used an arcane syntax guaranteed to baffle almost anyone. Microsoft Corp.'s DOS 6 changed that by including a menu-driven backup utility that compresses files and lets you save customized setup files to automate complex backup strategies. Microsoft Backup comes in two versions: the DOS-based MSBACKUP and the Windows-based MWBACKUP. These are subsets of the DOS and Windows versions of The Norton Backup. On-screen, the Norton and Microsoft versions look almost identical, but Norton's is much faster and has more features.

Microsoft Backup works only with floppy drives and devices that you can designate with a drive letter or pathname. If your backups won't fit on floppy disks or on DOS devices such as Bernoulli Boxes, Microsoft Backup won't be of much use to you. Even if you do use floppy disks for backup, you may become frustrated by Backup's sluggish performance. Unlike third-party backup software, Microsoft's doesn't use concurrent direct memory access (DMA) and therefore can't read from the hard disk and write to the floppy disk at the same time. Hence, Backup scored a distant last in PC Magazine Labs' timing tests.

BACK-GROUND

Microsoft Backup does provide some of the more elegant features of the Norton program. Both Microsoft and Norton use master backup catalogs that keep a log of a full backup and any subsequent partial backups until the next full backup. When you restore an individual file, you can select an option that lets you choose from all the versions of the file in a master catalog. You can retain or delete earlier catalogs each time you perform a full backup. Microsoft Backup uses MRCI compression, and reads backup files created by The Norton Backup with Norton's "Microsoft compression" option. (In all backup packages, a "full backup" is a backup of all files that you select in a backup set, whether or not the files have been changed since the previous full or partial backup. It isn't necessarily a backup of every file on your disk.)

Microsoft Backup is adequate only if you need to back up a few megabytes of files, or if you want a quick way to transfer large files or groups of files between computers. It won't restore backup disks made by the command-line backup program in earlier DOS versions; if you have such disks, hold on to the RESTORE program from your old DOS release. Backup disks created by Microsoft Backup can be restored by The Norton Backup, so you have a clear upgrade path. Meanwhile, you're a lot more likely to make backups with Microsoft Backup than you were with the old BACKUP and RESTORE combo. And slow backups are infinitely better than none at all.

Symantec Corp.

The Norton Backup for DOS
The Norton Backup for Windows

BY EDWARD MENDELSON

Historically, The Norton Backup, from Symantec Corp., has not always been the first backup package to offer new features. But when those features did arrive, Norton was generally the program that implemented them best. The Norton Backup for DOS, Version 2.2, and The Norton Backup for Windows, Version 2.2, each priced at $149, share a similar

HIGHLIGHTS

Backup and Restore

LIMITED FEATURES and abilities stunt Microsoft Backup. It's adequate only for systems where all you need to back up are a few megabytes of files or when you want a quick way of transferring large files.

THE NORTON BACKUP uses concurrent DMA access and is 150 percent faster than Microsoft Backup which, by the way, is based on earlier Norton Backup technology. However, the lack of SCSI tape drive support limits the otherwise powerful and reliable Norton Backup.

NO PRODUCT WAS FASTER than Central Point Backup in searching for an individual file during a tape restore. But lose the last disk or tape in a set (without a backup catalog on your hard disk), and it may not be able to restore your data from a backup.

WHEN USERS PANNED the nearly incomprehensible interface in Fastback Plus 3.*x*, Fifth Generation Systems responded with a retro look. Version 6.0's "new" face is heavily based on the popular interface from Versions 1.*x* and 2.*x*.

interface and almost identical features. Both versions provide the fastest backups available to floppy disk and QIC 40/80 tape, and they are the only backup packages totally compatible with the Microsoft Backup utility built into DOS 6.

A LOOK BACK

Although The Norton Backup and Microsoft Backup look alike, Norton uses concurrent direct memory access (DMA), which makes it at least 150 percent faster. Norton also provides an advanced menu with a wider range of options than you find in the Microsoft versions, and a "preset" menu that lets you choose from predefined backup setups that you can modify to suit your needs. Unlike Microsoft Backup, which backs up only to floppy disks or DOS devices, Norton also works with QIC 40/80 tape drives, including drives that use high-speed controllers. A major limitation is the absence of support for SCSI tape drives.

The Norton Backup can read any backup disk created by Microsoft Backup and even gives you the option to back up using the same compression format used by Microsoft Backup. This means that you can use Norton to restore or transfer files to systems that have only DOS 6. Norton's normal compression format is slightly faster than Microsoft's, but both Norton and Microsoft compression work at high speed when used by the Norton package.

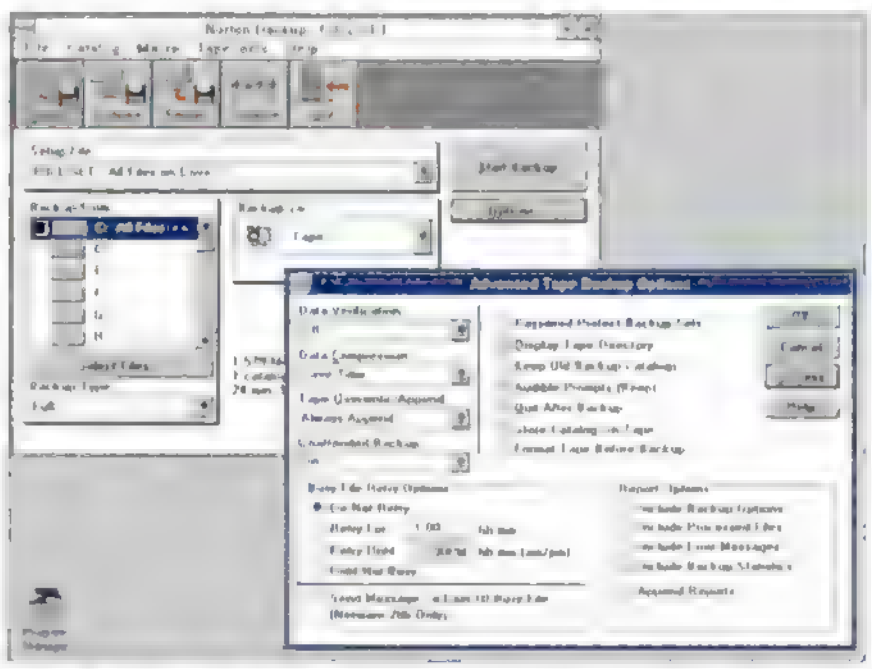
SECURE

Norton includes some impressive security options. It automatically drops back to slower DMA during a backup if it detects problems at the preset speed. It's the only package that lets you delete individual backup volumes from tapes while leaving the rest of the tape undisturbed. It also lets you overwrite erased tapes so that data can't be recovered. You can password-protect your backups, but you don't get the DES encryption option that you get with Fastback Plus for DOS or Central Point. If you lose one disk or tape in a backup, you can always recover the files on the remaining disks or tapes.

Norton makes file recovery simple. It uses a "master catalog" system that stores information about each full backup and all subsequent partial backups until the next full backup. This lets you easily recover different versions of a file backed up in any cycle between one full backup and the next.

DUPE POWERS

Like Central Point and Fastback Plus, Norton stores each of your backup specifications in setup files that you can use on a regular basis. When you create complex custom setups, you may find Norton's file selection system awkward. You can include and exclude files using both a fill-in menu and a graphic tree, but the rules that determine whether selections made on the menu override those made on the tree are inconsistent and confusing. This system is less opaque than Central Point's file selection system but less clear than Fastback Plus's system.



The Norton Backup for Windows lets you expand its options menu, as shown here, for access to advanced features.

Norton generally produced the fastest scores in PC Labs' timing tests, although the speed differences between Norton and Central Point probably wouldn't be noticeable in daily use. Norton was notably slower at locating a single file on a tape, because Central Point's Quick File Access catalogue lets it pinpoint a file rather than searching the entire tape.

Although The Norton Backup's lack of support for SCSI tape limits its usefulness in network environments, it's a solid and reliable package with a wide range of technically advanced options that insure trouble-free operation even on nonstandard computer systems. Because The Norton Backup is the only package that can exchange backup disks with Microsoft Backup, it's the obvious choice if you're looking for compatibility, reliability, and security.

▶ FACT FILE

The Norton Backup for DOS, Version 2.2
The Norton Backup for Windows, Version 2.2
List price: *$149 (included in The Norton Desktop for Windows, Version 2.2, $179).*
Circle 511 on reader service card

Central Point Software Inc.

Central Point Backup for DOS
Central Point Backup for Windows

BY EDWARD MENDELSON

Central Point Software's backup software comes in DOS and Windows versions, both of which work with almost any backup device you can imagine. The two versions are functionally identical, but you can buy them in four different packages. You get the DOS version with PC Tools for DOS, Version 8.0, for $179, and Central Point also sells it separately as Central Point Backup for DOS, Version 8.0, for $129.95. Similarly, the Windows version comes in the $179.95 PC Tools for Windows package, or separately as Central Point Backup for Windows, Version 2.0, at $129.95. Each version can read backups created by the other, and the Windows version comes with a DOS-based restore program that lets you recover from disaster without installing Windows first.

Central Point Backup offers everything you expect from modern backup software. It backs up to floppy disks, QIC 40/80 tape drives, including drives run from separate controller cards, SCSI tape drives connected to Adaptec controllers, and any device that you can identify by a pathname or drive letter. It's speedier than DOS 6's Backup, and works with every kind of hardware that DOS's backup ignores. It optionally scans for viruses during backups, and on a Novell network you can tell the program how often to return to an open file, whether to back up user privileges, and whether to list network drives by letter or name.

Performance Tests: Backup Software

Microsoft's backup tools in DOS 6 are substantially stronger, but they still haven't caught up with what the competition has. We tested them all to see if new features make a difference in their performance.

What the Numbers Mean

People commonly use backup software with two purposes in mind: data security and archiving. By backing up the computer's hard disk, users keep downtime to a minimum. Also, as users begin to fill their hard disks, they will often want to off-load seldom-used files. Still, the files must be stored in a way that provides for easy access later.

THE CONTENDERS PC Magazine Labs looked at the performance of the DOS and Windows versions of Microsoft Backup, Central Point Backup, Fastback Plus, and The Norton Backup in backing up and restoring an entire disk, as well as searching for individual files in a backup set.

SQUEEZE ME All of the backup program vendors except Microsoft provide an option for optimal compression or optimal speed. On the optimal compression setting, the program compresses a file as much as possible no matter how long it takes. Optimal speed, on the other hand, tries to calculate the best compromise between compression and speed. While the optimal speed setting may be useful on slower systems, the extra overhead of these calculations tends to make it slower than optimal compression on higher-end systems such as our test platform, a Compaq Deskpro 486/33M.

Some compression will almost always be preferable to none. Although compression requires additional processing, this is offset by the reduction in the amount of data that needs to be written to the disk or tape.

TIME IS ON MY SIDE One of the most important factors in measuring the speed of backup programs is how many megabytes of data can be backed up or restored per minute. The fastest programs, Central Point Backup and The Norton Backup, both sustained a rate of nearly 4MB per minute when set to the highest compression level. Microsoft Backup, on the other hand, could barely process more than 2MB per minute.

MY OWN FORMAT Both Central Point Backup and The Norton Backup can also use their own proprietary formats to initialize floppy disks. Backups in all but The Norton Backup for Windows were actually slower in these proprietary formats. But restoring data was much faster in all cases. Since users tend to do much more backing up than restoring, they're probably better off forsaking these formats.

Fastback Plus provides an alternative format that is fully DOS-compatible but writes sectors in a manner that minimizes the floppy disk's interleave (the number of disk rotations required between each sector's reads or writes). We found no improvements in speed using this format. In fact, restores in Fastback Plus for DOS took more than 15 percent longer.

WHERE'S THE TAPE? In today's world, where few computers are sold with hard disks smaller than 80MB and at least 120MB is a common recommendation, backing up to floppy disks becomes less and less practical. Consider that backing up an 80MB hard disk would require at least 28 floppy disks, even at 2:1 compression. The same amount of data could easily be stored on a QIC-80 tape with room to spare.

Tape backup software was once solely the domain of the tape drive manufacturers. As standards have emerged for tape drives, the floppy disk backup software vendors have gotten into the game.

Only Fastback for Windows and Microsoft Backup do not support tape drives. On our Tape Backup and Restore tests, Central Point Backup for DOS stood out as especially slow. In fact, its tape backups were no faster than its floppy disk backups.

Central Point Backup for Windows, Fastback Plus for DOS, and The Norton Backup sustained fast rates of over 7MB per minute on our Tape Backup test. On the Restore test, the programs were even faster, approaching 8MB per minute.

OOPS! If you have ever inadvertently deleted a file or overwritten accurate data with bad data, you'll appreciate a program that can search for a backup of the file and get to it quickly. Especially on a tape drive, search speed is an issue. Floppy disks allow random access of data; you can quickly find a file anywhere on a disk. Tapes, on the other hand, are sequential in nature; it's like moving from the first song to the last on a cassette tape. Hence they must be able to move quickly past nonrelevant data to the file you need.

Central Point Backup for DOS redeemed itself on our Search test. Using Quick File Access, both the DOS version and its Windows sibling were about two times as fast as The Norton Backup, and six times as fast as Fastback Plus for DOS. Fastback was no faster at restoring a single file than it was at restoring the file *and* all the files in the data set leading up to it.

To work properly, the program must be set to the same interrupt, DMA channel, and I/O address as the tape drive. None of the programs were able to locate the tape drive automatically. Fastback allowed us to change only the DMA and I/O address, and these changes could not be made from within the program. Instead, we had to edit the program's INI file manually. Both Central Point Backup and The Norton Utilities let you change the tape drive settings as a menu option.

How We Tested

The data used in all **Optimal Compression** and **Optimal Speed** tests was a complete installation of Microsoft Word for Windows (approximately 14MB). This yielded a real-world mix of program files and data files. Because performance tends to be linear (that is, a certain amount of overhead plus *x* kilobytes per second), we tested with both a single and double installation (28MB) of Microsoft Word for Windows. This let us assess how much of the backup time could actually be attributed to backing up, restoring, and/or searching the data. The charts present only the results for the larger data set.

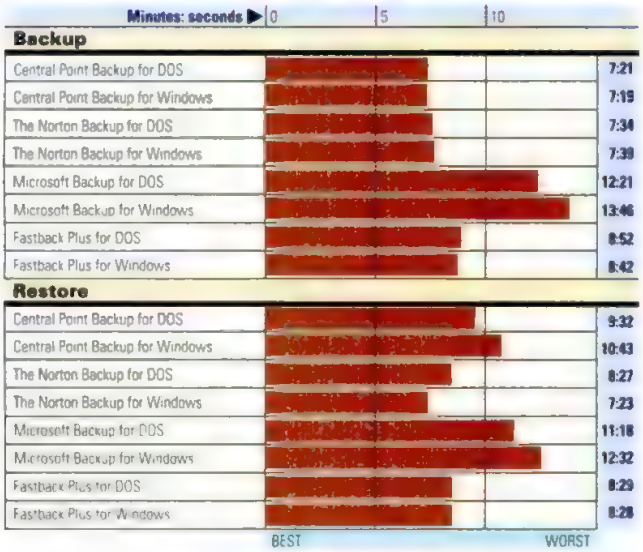
COPY CONFIGURATION We tested backups and restores with every combination of the following settings: format (DOS or proprietary), compression (optimal speed or optimal compression), and media (floppy disk or tape).

To test search speed, we instructed the program to restore a 1-byte file that was the very last file in a tape backup set.

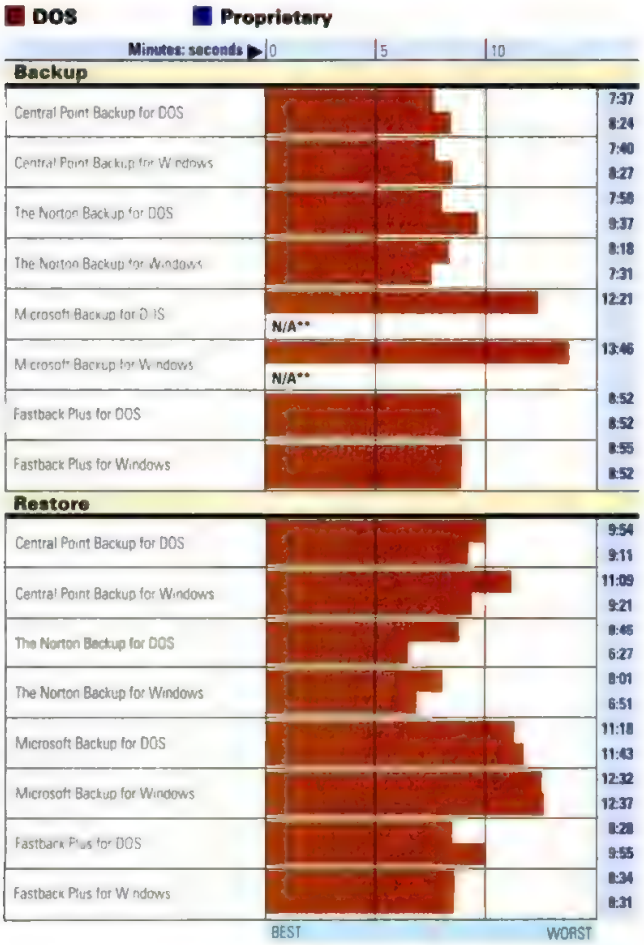
Except for the two versions of Microsoft Backup, all programs were set to high-speed DMA, which improves performance by allowing simultaneous reads and writes. Microsoft does not offer an option to back up using DMA. Avoiding the use of DMA does minimize incompatibilities. Still, all the other programs offer the option of turning DMA off if you are having problems.

FLOPPY DISK

Optimal Compression (DOS Format)

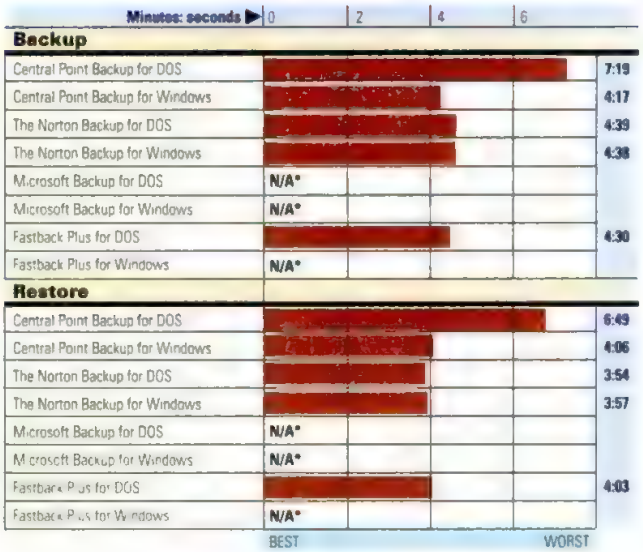


Optimal Speed

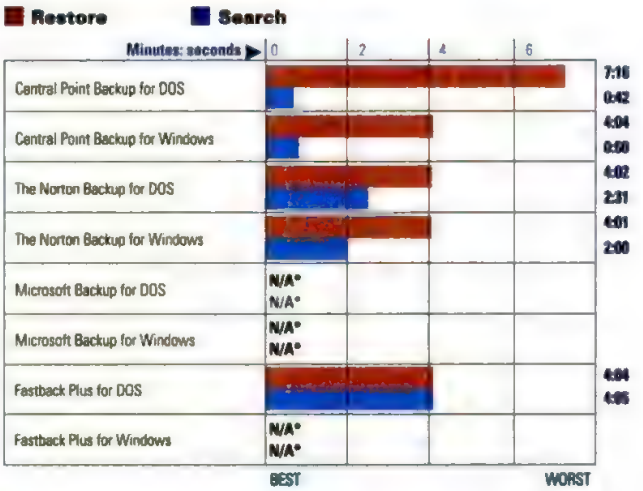


TAPE

Optimal Compression (QIC-80 Format)



Optimal Speed



N/A*—Not applicable. This program does not support a tape drive.
N/A**—Not applicable: Microsoft Backup does not provide a proprietary format for backup disks

OUR TEST-BED We ran all tests on identically configured Compaq Deskpro 486/33Ms, each with 8MB RAM, a 340MB hard disk, two 3.5-inch high-density floppy disk drives, and a Colorado Jumbo 250 tape drive connected to a Colorado FC-10 high-speed controller.

Central Point Backup for Windows lets you view files in their native formats when selecting them for backup.

MOSTLY THE SAME

The DOS and Windows versions present almost identical menu structures. Both versions let you select different menu levels for novice, intermediate, or advanced users, and system administrators can set a password to prevent users from changing their menu level.

They both include viewers that let you see the contents of your files before deciding whether to back them up, and both let you encrypt your backups or apply simple password protection. You can bypass the menus by using command-line options for backups and restores, and restore individual files by typing their file specs as command-line parameters.

In PC Labs' tests, Central Point generally scored a close second to The Norton Backup, although it was especially fast in searching for an individual file during a tape restore. The Windows version performed at roughly the same speed as the DOS version when working with floppy disks, but was notably faster with QIC tapes, where the DOS version's scores were generally low. In informal tests with a SCSI DAT drive, the Windows version backed up and verified 650 MB of data in 1 hour 48 minutes—about ten minutes behind the DOS version of Fastback Plus. The manual warns that in certain types of backups—not all—you can lose the entire backup if you lose the last disk or tape in a set, and you don't have a backup catalog on your hard disk.

BACKUP BOGGLE

The program's most confusing aspect is its method of handling file selections. A fill-in-the-blank menu lets you type in file specifications to include or exclude from a backup. Alternatively, a graphic directory tree lets you include or exclude directories or files by selecting and deselecting them with your mouse or keyboard. The selections that you make from the tree, however, override the specifications that you enter in the menu. But if you first select from the tree, then go the menu to refine your choices, the selections made from the tree are instantly wiped clean.

This file selection awkwardness is a minor annoyance in a powerful and well-established program. If you need a DOS or Windows backup package that works reliably on any system in your office, one of these Central Point products may be your best choice.

▶ FACT FILE

Central Point Backup for DOS, Version 8.0
Central Point Backup for Windows, Version 2.0
Central Point Software Inc., 15220 Northwest Greenbrier Pkwy., Beaverton, OR 97006; 800-445-4208.
List price: *$129.*
Circle 512 on reader service card

Fifth Generation Systems Inc.

Fastback Plus for DOS
Fastback Plus for Windows

BY EDWARD MENDELSON

Fifth Generation Systems' $149 Fastback Plus for DOS, Version 6.0 looks much like the highly popular Versions 1.*x* and 2.*x*. Version 3.*x*—which was released immediately prior to 6.0—used an almost incomprehensible menu system, provoking so many complaints that Fifth Generation replaced it with a package that looks and works more like the original versions but supports QIC 40/80 tape drives, with or without high-speed controllers, and SCSI tape drives.

One innovative new feature is Fastback Plus's ability to make a tape drive on any computer in a LAN accessible as a backup drive for any other computer in the network. The package also lets you back up from one computer to another with a $20 parallel cable from Fifth Generation. Other conveniences not found elsewhere include an option to shell to DOS and menus that let you delete files from your hard disk. If you lose a disk or tape in a backup, you can still restore from all the other disks and tapes.

Fastback lets you choose among several menu levels, each with a different range of options. File selection is simple and intuitive. You can choose files to include or exclude by entering file specifications in a menu or selecting them from a graphic tree. Both selection methods are conveniently accessed from the same screen.

Fastback Plus for Windows uses the Multiple Document Interface to display and iconize multiple menus at the same time.

The program comes with 26 preset groups of file specifications to speed up inclusion or exclusion of standard categories. System administrators can back up and restore Novell network user privileges. Backups can be password-protected and encrypted. You can view individual ASCII files before backing them up, but the program gives an error message if you try to look at word-processing, spreadsheet, database, graphics, or other files viewable in Central Point Backup or The Norton Backup.

Fastback includes a simple but effective macro language letting you record complex sequences of backups and compares. Macros can be programmed to display messages, and the package includes

"DISK COMPRESSION IS INHERENTLY MORE FRAGILE... ...USERS OF COMPRESSION SHOULD HAVE A COPY OF NORTON UTILITIES 7.0."

PC Week - May 10, 1993

Peter Norton, the leader in data recovery software.

The new compression technology can put you in a squeeze. You wanted the efficiency, but now you're worried about losing data.

Here's some news that might help you relax. No other single product gives you the complete compressed data protection of Norton Utilities® 7.0.

It's the only utility specifically designed to recover data from DOS 6.0 DoubleSpace, Stacker and SuperStor compressed drives. Only with our Speed Disk® feature can you truly defragment the drives, making your recovery a fast, painless process.

You also get the Norton Disk Doctor,® with its nine automated repair functions specific to compressed drives. Plus the new Norton Diagnostics, which analyzes and tests all vital system components, including memory, video, CPU, system boards, communication ports, keyboard, mouse and more.

You can't put a price on peace of mind. But we'll try. So call FAST FAX today and discover the ultimate security of Norton Utilities 7.0. It just might get you out of a tight spot.

THE NORTON UTILITIES

SYMANTEC.™

For complete information about Norton Utilities 7.0, dial FAST FAX 1-800-554-4403, select option 1, document 447.

For more information in Europe, call 31-71-353111. In Australia, call 61-2-879-6577. In Canada, call 1-800-667-8661. Everywhere else outside U.S., call 408-252-3570. The Norton Utilities, Norton Disk Doctor and Speed Disk are registered trademarks of Symantec Corporation. Other names are trademarks of their respective holders. Compatible with Windows 3.0 and 3.1, DOS 3.3 and higher. ©1993 Symantec Corporation. All rights reserved

CIRCLE 344 ON READER SERVICE CARD

Defragmenters and Multiboot: *Organization or Complication?*

by Edward Mendelson

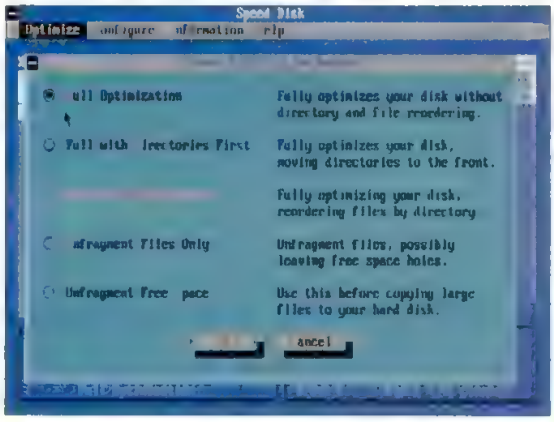
Two of the many features built into DOS 6—but formerly available only through third-party software vendors—are hard disk defragmentation and a menu system that lets you boot into different configurations for different purposes. Defragmentation can save you time and help preserve your data, and multiboot options let you use your system most efficiently.

When you first copy files to your hard disk, each occupies one contiguous region of the disk, and your files are packed next to each other with no empty space in between. As you delete old files, space opens up between your existing files, and as your disk gets filled, DOS tends to divide newly created or copied files into two or more fragments and insert those fragments in the space left between files. Fragmented files take longer to load than contiguous files and are harder to recover if you delete them accidentally. The main functions of a defragmenter are to reunite divided file fragments and to pack files together at the front of your disk so that the drive heads don't have to work as hard to read files.

DOS's defragmenter is called Defrag. Your basic choices with Defrag are full optimization, which defragments files and packs them together, and defragment only, which leaves spaces between files but is faster than full optimization. You can also specify the order in which Defrag sorts files as it's reorganizing your disk.

A BETTER CHOICE

These may or may not be all the options you need; Defrag has its limits. For example, it can't defragment the files in a DoubleSpace container file or a CVF (compressed volume file) created by any other compression software. (A separate command, DBLSPACE /DEFRAG, will move all the free space in a container file to the end of the file, reducing the size of the container file.) For this feature, as well as many options that squeeze better performance out of uncompressed disks, the obvious choice is the Speedisk program that comes in The Norton Utilities. (Defrag is a reduced version of Speedisk.) Speedisk lets you place all your directories at the front of your disk for fast access, and you can specify the order of your directories. You can also specify files that shouldn't be moved because of old-fashioned copy-protection schemes that shut down a program if a hidden file moves from the place where it was first written.



The SpeedDisk defragmenter in The Norton Utilities includes options left out of the reduced version in DOS 6.

Central Point Software's PC Tools for DOS includes a Compress utility with features and performance virtually identical to Speedisk's, except that it can't defragment files in DoubleSpace or other compressed disks as Speedisk can. The compress program in PC Tools for Windows, called Optimizer, doesn't defragment DoubleSpace disks, either. It does, however, perform the amazing feat of defragmenting ordinary disks while you work in other Windows applications. It grinds to a halt when another application writes to disk, but you can set it to start up again after a specified interval of idle time. Normally, defragmenting is something to do during a coffee break, but PC Tools for Windows lets you be productive even as your disk becomes more efficient.

For the most finely tuned fragmentation available, choose FastTrax International's $70 FastTrax, Version 4.0, which lets you specify which files to place at the front of your disk and which to place out of reach at the end. It lacks the fancy graphic display that you get with Compress, Defrag, and Speedisk, but it's the only program that lets you organize your disk exactly the way you want it. A version due by the time you read this will defragment DoubleSpace disks. (FastTrax International, 510-525-3510.)

MULTIBOOT

Those who have ever edited and re-edited a CONFIG.SYS and AUTOEXEC.BAT file so that they could temporarily add or remove a TSR or device driver will be delighted by DOS 6's built-in multiple-configuration manager. A simple set of commands added to your CONFIG.SYS file and some simple GOTO lines added to AUTOEXEC.BAT will let you display a menu of up to nine alternate configurations every time you boot. One configuration might include network drivers. Another configuration might leave out the network drivers for increased available RAM. Another might be optimized for

Windows or DOS. Each menu can have its own screen color, and each can include submenus. Because the menu system is built into DOS, you don't need extra files or device drivers to use it.

BOOT CAMP

If you want more advanced options, such as custom shortcut keys for choosing a configuration and password protection, consider a third-party alternative. Modular Software Systems' $79 Bootcon supports up to 100 configurations and comes with a menu-driven configuration editor that lets you manage and alter all your configurations without learning an arcane command syntax. It also lets you automatically associate different WIN.INI files—or any other configuration file—with each of your boot configurations. Bootcon litters your configuration files with obscure commands and creates a complex directory structure, but the resultant menus are flexible and attractive, and you can use them as a front end to create multiboot configuration files of the kind supported directly by DOS 6. (Modular Software Systems, 800-438-3930; fax, 206-631-5779.)

You can find other multiboot managers in commercial and shareware programs. Among the more elegant are V Communications' $60 Boot Commander, which provides an attractive interface on boot-up—complete with optional sound effects. (V Communications, 800-648-8266.) The most powerful multiboot software is probably Hans Salvisberg's $39 BOOT.SYS, Version 2.0, available in a shareware version as BOOTSY.ZIP in CompuServe's IBMSYS forum library. This unique program offers if/then/else logic during boot-up and even lets you edit lines in your CONFIG.SYS file or rename files while CONFIG.SYS is being processed. DOS 6's built-in multiboot has all the basic features that most users will want, but BOOT.SYS has the advanced features that demanding and expert users will need. □

a TSR (terminate and stay resident) scheduler that runs macros at specified times. Fastback won't let you backup or restore files from the command line. In PC Labs' tests, Fastback Plus for DOS generally lived up to its name. With QIC tapes, it ran closely behind The Norton Backup's best score. Its floppy disk performance was notably lower than that for both rival packages, although far ahead of DOS's built-in Backup. In informal testing with a SCSI DAT drive, Fastback backed up 650MB of data in one hour 35 minutes—a slightly faster time than Central Point Software's Windows version. But, unlike Central Point Backup, Fastback slowed to almost half that speed with file compression switched on, and because, unlike Central Point, Fastback doesn't use the Quick File Access method to search for files, the restoring of individual files may be very slow.

The Windows version, Fastback Plus for Windows, Version 1.0, also priced at $149, looks different from the DOS version and does much less. Except for greater speed, it isn't much of an advance on the Windows backup program that comes with DOS 6.0. Fastback's Windows backup supports only floppy disks and DOS devices, although Version 1.1, due out by the time you read this, will add QIC 40/80 tape drives. It won't support SCSI drives, however, and won't match the extensive feature set of the DOS version.

If, like many users, you prefer using DOS to Windows for data-critical tasks like backups, Fastback Plus for DOS offers speed, convenience, and the unique ability to back up to a tape drive from anywhere on a network or between two computers attached by a parallel cable.

▶ FACT FILE

Fastback Plus for DOS, Version 6.0
Fastback Plus for Windows, Version 1.0
Fifth Generation Systems Inc., 10049 North Reiger Road, Baton Rouge LA 70809; 800-873-4384.
List price: *$149.*
Circle 513 on reader service card

Data Recovery

Getting Smarter and Doing It Better Than Before

Microsoft Corp.

Microsoft Undelete

BY EDWARD MENDELSON

Millions of DOS users who never had the inclination to buy a separate utility package will find that the utilities that were introduced in DOS 6 can save the life of their data. The major data-saving enhancements in DOS 6 are an improved Undelete utility and an antivirus program. Microsoft licensed both of these additions from Central Point Software. Central Point's current undelete and virus protection software include many more features than DOS 6.

DOS 5 included a Undelete program, but the enhanced version in DOS 6 does far more. While DOS 5 could keep track of the location on disk of the data in deleted files, it couldn't keep the data from being overwritten by other files. DOS 6 can optionally safeguard deleted files in a hidden directory where they can't be overwritten and from which they can be recovered with complete confidence. DOS 5's method, which is still available in DOS 6, is called Delete Tracking; DOS

HIGHLIGHTS

Data Recovery

DELETE SENTRY, DOS 6.0's new data recovery tool, can almost guarantee recovery of deleted information by optionally safeguarding deleted files in a hidden directory where they can't be overwritten. Windows support and virus protection also help protect and retrieve your precious data.

THE NORTON UTILITIES, which includes Disk Doctor (the only MD in the group), Undelete, Unformat, and the ability to defrag a Double-Spaced drive, is still the best package on the market for restoring data from a scrambled or damaged hard disk.

CENTRAL POINT SOFTWARE licensed older versions of its Undelete and Anti-Virus utilities to Microsoft for DOS 6. But the corresponding utilities that it put into its current PC Tools for DOS and Windows have more features and a smoother interface.

6's guaranteed recovery method is called Delete Sentry. Both use a 10-14KB TSR that you launch by adding a parameter to the Undelete command.

Files that are stored by Delete Sentry stay on your disk seven days unless you clear them out first; they are limited to 20 percent of disk space. Both the time and space limitations can be changed by editing the UNDELETE.INI file in your DOS directory.

WINDOW OF OPPORTUNITY

The Windows version of Undelete is more elegant than the command-line-only version available under DOS and lets you select deleted files from a menu. But neither version lets you view a file before undeleting or allows you to rebuild a file from clusters on the disk. Both features are standard in third-party utility packages.

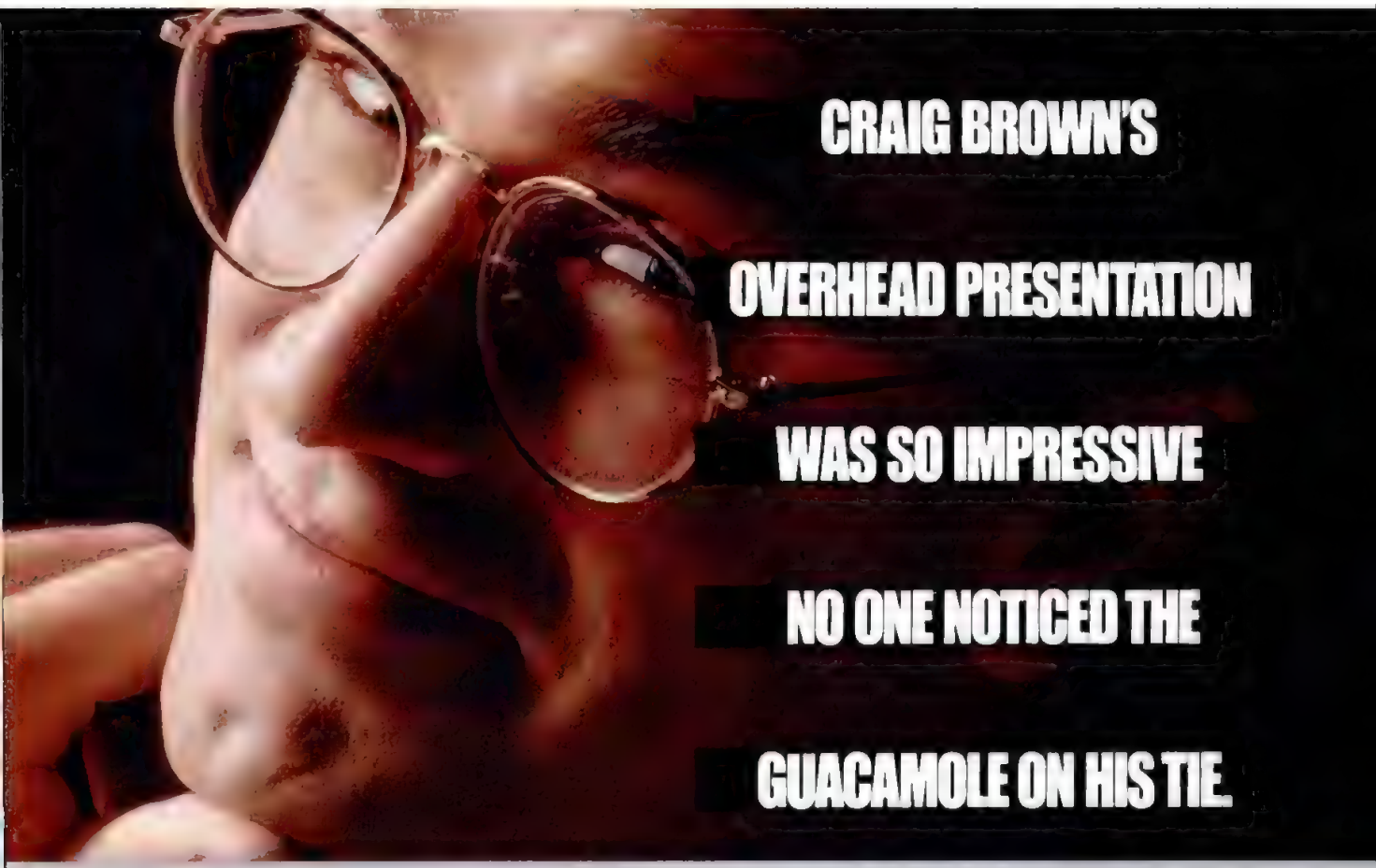
DOS's antivirus software consists of VSAFE, a 23KB TSR that detects virus attacks on your disk as they occur, and MSAV, a program that scans your disk for viruses and optionally removes them. Both lack the most advanced protection methods found in standalone antivirus software, like the ability to detect altered versions of files, but DOS's version is more than adequate for most computing environments.

Symantec Corp.

The Norton Utilities

BY EDWARD MENDELSON

DOS users in search of airtight security for their hard disks have traditionally turned to Symantec Corp's $179 The Norton Utilities, and Version 7 won't disappoint them. Norton includes menu-driven programs that recover deleted



files or reconstruct damaged word-processing, spreadsheet, and database files. The Norton Utilities also includes Disk Doctor, which is the best-designed utility currently on the market for restoring data from a scrambled or damaged hard disk, and a uniquely powerful disk editor that lets experts manipulate the most arcane elements of a disk's directory structure.

The Norton Disk Doctor (NDD) acts like a supercharged, menu-driven counterpart of DOS's CHKDSK. It analyzes the directory structure of your disk and makes heroic efforts to restore order to your damaged File Allocation Tables or directories.

Command-line switches in NDD let you automate otherwise time-consuming tasks like removing embedded spaces in DOS filenames, which make the files difficult to access or delete.

BRING IT BACK

Norton's Unerase program displays exceptional intelligence in recovering lost files, and its menu-driven mode is far more friendly than DOS's laconic command-line Undelete. You can also piece together deleted files from stray clusters on the disk—something you can't do with DOS's Undelete. Norton lets you view the contents of deleted files before trying to recover them, something you can't do even in the menu-driven Windows-based Undelete program that comes with DOS 6. If you warehouse deleted files temporarily with either Norton's SmartCan TSR or DOS 6's less powerful Delete Sentry option for the TSR portion of its Undelete program, Norton can restore them with guaranteed success. Norton can also use the pointers to the locations of deleted files that are stored by the Delete Tracking option in DOS 6's Undelete.

Norton's Unerase also works with Norton's Image utility, a program that, when run from the command line, stores a record of the current location of your files. This method gives you a reasonably high level of protection from accidental deletions without the overhead of a TSR.

The Norton Utilities doesn't include antivirus software, but Symantec sells a separate Norton AntiVirus package for $129, which recently shared PC Magazine's Editor's Choice rating with Central Point Anti-Virus (see "Antivirus Software: Keeping Up Your Guard," *PC Magazine*, March 16, 1993). You get a Windows version of the AntiVirus package, together with unerase utilities and the Norton Disk Doctor, in Symantec's $179 The Norton Desktop for Windows Version 2.2. The Windows-based Unerase doesn't permit manual recovery of stray clusters, and the Windows-based Norton Disk Doctor reports on disk damage but can't correct it. Fortunately, the Norton Desktop for Windows package also includes the more powerful DOS versions of these and other programs from The Norton Utilities.

▶ **FACT FILE**

EDITORS' CHOICE The Norton Utilities, Version 7.0
Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014; 800-441-7234.
List price: *$149; The Norton Desktop for Windows, Version 2.2, $179.*
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Performance Tests: Restore and Recover

Predictably, every utility we tested was able to recover files that had been deleted recently or that were protected by delete-tracking software. But neither of MS-DOS's undelete utilities nor any Windows-based undelete program was able to recover a file manually or to repair damaged data files. The Norton Utilities and PC Tools for DOS both successfully located data that helped make manual file recovery feasible. When tested with a 120MB hard disk, the Norton Disk Doctor and the DiskFix programs in PC Tools for Windows and PC Tools for DOS all successfully repaired FATs that included circular cluster chains and other filing-system errors. DOS's CHKDSK reported all the errors but could successfully repair only minor ones.

When we tested with the programs with a 1.2GB SCSI hard disk connected to an AMI SCSI-2 disk controller, both the DOS and Windows versions of DiskFix locked up when first accessing the disk, though the Norton Disk Doctor worked with the disk easily. PC Tools' DiskFix works with equally large hard disks in other configurations; changes that let DiskFix work with this particular configuration are expected in the next release.

How We Tested

PC Magazine Labs tested each package for its ability to recover deleted files, repair damaged files, and rebuild files manually from scattered data on the disk. We also tested these packages' ability to restore damaged FATs and directories and to edit data directly on the disk by accessing the disk at the sector level (in contrast to DOS, which gets data from the disk in the form of clusters made up of separate sectors).

Central Point Software Inc.

PC Tools for DOS
PC Tools for Windows

BY EDWARD MENDELSON

Central Point Software's PC Tools has always included the most comprehensive set of utilities in a single package. Version 8.0 of PC Tools for DOS and Version 1.0 of PC Tools for Windows both work smoothly with DOS 6 and provide smooth upgrade paths for DOS's built-in undelete and antivirus software. PC Tools for DOS includes an automated disk-fixing program, a disk editor, and a program that automatically repairs damaged documents created in leading word processors, spreadsheets, and databases.

The Undelete program in PC Tools for DOS lets you select files from a menu, unlike the command-line-only version in DOS 6.

When you use Microsoft's Undelete, Unformat, and Anti-Virus (MSAV) programs in DOS 6, you're using utilities originally written by Central Point for old versions of PC Tools. The corresponding utilities in the current versions of PC Tools for DOS and Windows resemble the DOS utilities but include more features and a smoother interface. PC Tools' Undelete program uses the same Delete Sentry and Delete Tracker data used by DOS's Undelete, but it also offers a menu from which to choose deleted files and view their contents, and functions that let you rebuild files by hand from clusters on your disk. PC Tools' Windows Undelete doesn't let you build files by hand but it does include viewers, which you don't get in DOS.

Central Point data-recovery software lags behind Norton in advanced features but is unmatched for economy and range.

THE RIGHT TOOLS

PC Tools for DOS has a disk editor and a DiskFix program for automated disk repairs. Except for CHKDSK, DOS has no comparable program for advanced repairs of damaged directory structures. Both these PC Tools utilities resemble programs in The Norton Utilities but lack some of Norton's most advanced features. However, while DiskFix in PC Tools for Windows can repair a disk, the corresponding Norton program can only report the damage.

The DOS and Windows versions of PC Tools include enhanced and updated versions of the Microsoft Anti-Virus software found in DOS. You can buy these enhanced programs in separate $129 packages called Central Point Anti-Virus for DOS and Central Point Anti-Virus for Windows. The Windows package (called Version 2.0) is an updated and enhanced version of the antivirus program in PC Tools for Windows, but the DOS package (called Version 1.4) matches the antivirus software in PC Tools for DOS. Version 1.4 of the DOS and Windows packages shared Editor's Choice honors with The Norton AntiVirus in a recent PC Magazine survey (March 16, 1993). Both the Central Point and the DOS antivirus programs use the same Central Point virus signature list. You can get updates from Central Point's BBS or from CompuServe.

Central Point's data-recovery software is uniformly powerful and flexible. Overall, it lags slightly behind Norton in advanced features but is unmatched for economy and range. Both the DOS and the Windows versions of PC Tools offer smooth-fitting additions to the safety features built into DOS 6. □

▶ FACT FILE

PC Tools for DOS, Version 8.0
PC Tools for Windows, Version 2.0
Central Point Software Inc., 15220 Northwest Greenbrier Pkwy., Beaverton, OR 97006; 800-445-4208.
List price: *$179.*
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results and reader feedback continue to suggest that DOS 6.0 DoubleSpace is causing significant problems on a wide variety of DOS machines.

– *InfoWorld*
May 10, 1993

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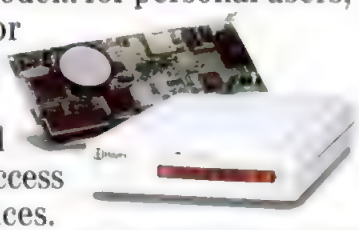

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17-INCH MONITORS

A Wider View

We test 34 new 17-inch monitors—most of which cost under $1,000.

One day it hits you. The 14-inch color Super VGA monitor that the dealer bundled with your PC has become too small for your needs. You don't have room to keep several windows open when working with multiple applications. You find yourself yearning for a big high-resolution monitor.

Should you take out a second mortgage and buy a 21-inch monitor? Before you risk sending your credit rating into a nosedive, consider a compromise. Splitting the difference between those impossibly expensive 21-inch hulks and the 14-incher you're growing out of

by Don Crabb

Photography by Robert Cardin

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is a good alternative: a 17-inch monitor.

PC Magazine and ZD Labs have put together a comprehensive roundup of 17-inch monitors to assist you in your search for the 17-incher that best fits your needs. We look at 34 high-resolution color monitors from major manufacturers.

REVIEW CRITERIA

To be included in our review, we required products to be 17-inch color monitors offering at least 1,024-by-768 resolution. Products needed to have at least 15.5-inch diagonal viewable screens and also needed to comply with the VESA refresh standards of 72 Hz in 800-by-600 mode and 70 Hz in 1,024-by-768 mode. Products needed to be shipping in the U.S. in substantial quantities to end users by our testing period of mid-May. We asked vendors to submit one unit each, with the exception of vendors with significant market presence (NEC Technologies and Samsung Electronics America) and manufacturers of Editors' Choice recipients honored in our previous roundup of 17-inch-monitors (Nanao USA Corp., NEC, and ViewSonic). These vendors could submit two. We did not test beta products.

We tried to look at even more 17-inchers, but—for a variety of reasons—several vendors did not submit monitors. These vendors included ADI Systems, Arche Technologies, CTX International, Darius Technology (U.S.), Delta Products Group, ETC Computers, Goldstar Technology, Identity Systems Technology, Iocomm International Technology Corp., Mitsubishi Electronics America, Neotec International, Qume Peripherals, Ran-Ger Technologies, Sunshine Technologies, Tatung Co. of America, Taxan America, TVM Professional Monitor Corp., and Wen Technology Corp. Aamazing Technologies submitted a monitor that was not included because it did not pass our viewable-screen size filter. Some vendors were just about to introduce newer 17-inch models but could not make them available in time for our testing procedures. These vendors included Compaq Computer Corp., IBM Personal Computer Co., Mitsubishi, Sceptre Technologies, SuperMac Technology, and Wyse Technology.

WHY A 17-INCHER?

The reasons to purchase a 17-inch monitor are simple. Such monitors provide approximately 45 percent to 60 percent more screen real estate than 14-inch monitors offer (depending on how overscan is set), while keeping the size of their color-picture tubes small enough to be more cheaply manufactured than the tubes of larger monitors (19-, 20-, and 21-inch, and beyond).

Seventeen-inch monitors also are considerably lighter and less bulky than the 19- to 21-inch models. Take the NEC line, for example: The 21-inch NEC MultiSync 6FG is 22.4 inches deep and weighs 79 pounds, while the 17-inch NEC MultiSync 5FG is 19.8 inches deep and weighs 56 pounds. But price is the primary reason most users don't purchase 21-inch monitors. A 21-inch model typically lists for $2,000 to $3,000, while 17-inch models generally are in the $1,000 to $1,500 range.

Even at these prices, 17-inch monitors are too expensive for many users. This is why many vendors are introducing value-line models that land on the lower end of this scale (the $1,155 NEC MultiSync 5FGe, for example). By offering fewer features and lower performance, vendors are cutting costs, and increasing numbers of low-end, sub-$1,000 17-inch monitors are becoming available. Eight of the 34 models here have list prices below $1,000, and more than half sell for less than $1,000 on the street.

Another point in favor of 17-inch models over 14- and 15-inch monitors is their higher resolution. The 14-inch monitors run VGA well and SVGA satisfactorily. Most 17-inch models run well at SVGA and 1,024-by-768 resolutions. While many 17-inch monitors are capable of running in 1,280-by-1,024 mode, it is impractical to run them at that resolution (likewise 14-inch monitors at 1,024-by-768); the information displayed is too small.

Seventeen-inch models running at higher resolutions let you display more information (icons, text, graphics, and so on) on-screen. For people with mediocre eyesight, information displayed at lower resolutions (VGA) on large monitors is easier to read.

The overwhelming majority of monitors in use, and shipping, are still 14-inch models. About 2 million 14-inch units, or 76 percent of the total U.S. monitor market, shipped during the first quarter of 1993, according to Monitrak, a report published by Stanford Resources in San Jose, Calif. The 17-inch market, while growing, comprised only about 5 percent of total U.S. monitor shipments during this period, while all sizes above 17 inches together constituted another 2 percent of this market, according to Monitrak's figures.

Keep in mind that all monitors are measured diagonally between tube corners; this is the specification manufacturers use when discussing the size of

their units. All the monitors in this roundup have a 17-inch tube, but the actual diagonal viewable area is usually 15.5 to 16 inches—just as the actual diagonal viewable area of a 14-inch CRT (cathode-ray tube) is about 13 inches. The range of measurable viewing areas of the 34 monitors here is 15.5 to 16.25 inches. There are only a handful of monitor tube manufacturers, and the 34 monitors tested use tubes made by one of these seven vendors: Hitachi America, Matsushita, Mitsubishi Electronics America, NEC, Sony Corp. of America, Toshiba America Information Systems, and Zenith Data Systems.

If you want to take full advantage of Microsoft Windows 3.1, Windows for Workgroups, Windows NT, or, indeed, any PC-based GUI (graphical user interface), you should consider purchasing a 17-inch high-resolution monitor. Before you do, however, you will want to consider several factors. Be sure you familiarize yourself with a potential purchase's true color capability, the clearness of its picture, and the ergonomics of its design.

MONITOR EMISSIONS

You may also be concerned about the amount and direction of extremely low frequency (ELF) and very low frequency (VLF) electromagnetic radiation emitted by a monitor. We tested all the monitors for compliance to standards developed by the Swedish government's National Board of Measurement and Testing, using a subset of the so-called MPR II standards.

All the tested monitors passed the MPR II guidelines for ELF, but five monitors failed the VLF tests: the Amdek AM/817, the KFC CA 1713, the Relisys RE-1764, the Samtron SC-726V, and the Sceptre CL-617. None of the monitors that failed claimed to be MPR II–compliant, however. Failing the VLF tests means that a monitor's horizontal deflection circuits are not well shielded. Although you should consider radiation protection when purchasing a monitor, the evidence is still unclear about what problems, if any, monitor emissions can cause. Many researchers, however, consider monitor radiation a potential public-health concern.

OBJECTIVE TESTS

The objective tests ZD Labs administered are described in the "How We Tested" section. We used the MicroVision SuperSpot 100 and Minolta Color Analyzer CA-100 tests to measure performance characteristics (barreling, convergence, curvature, keystone, pincushioning, regulation, screen-bounce effects, and tilt).

Each monitor was tuned to maximum sharpness by eye and then tested under the SuperSpot. Note that the SuperSpot is sensitive enough to pick up slight flaws

PC MAGAZINE ▶ EDITORS' CHOICE

- **Nanao Flexscan F550i-W**
- **NEC MultiSync 5FG**
- **Sony CPD-1730**

When it comes to monitors, you get what you pay for. Our three Editors' Choice winners—the Nanao Flexscan F550i-W, NEC MultiSync 5FG, and Sony CPD-1730—are on the higher end of the price spectrum, and their picture quality, features, and performance were the finest of the 34 17-inch monitors we tested. All three are excellent choices for Microsoft Windows and OS/2 use at Super VGA (800-by-600) and 1,024-by-768 resolutions.

Fortunately, the cost for quality is coming down. A year ago the list price of the Nanao Flexscan F550i was $1,749. Today it costs $1,499, and its newer sibling, the Flexscan F550i-W (with energy-saving features), is $1,599. Moreover, we have seen street prices of $1,118 for the Flexscan F550i-W and $990 for the Sony CPD-1730. The MultiSync 5FG, which lists for $1,355, is selling for $1,290 on the street.

Five other monitors merit honorable mentions: the MAG MX17F, Nanao Flexscan F550i, NEC MultiSync 5FGe, Panasonic PanaSync/Pro C1795E, and ViewSonic 17. Their performance was impressive but not as good as that produced by the three Editors' Choices.

Of the remaining 25 monitors in this review, we believe 15 offer sufficiently attractive price/performance combinations that are worthy of your consideration. You won't be disappointed with the monitors provided by Acer, Addonics, Amax, AOC, Compaq, E-Machines, IBM, Idek, Liberty, Optiquest, Seiko, Sigma Designs, Swan, ViewSonic, and ZDS. You can find several of these monitors for less than $1,000 on the street.

What if you want the cheapest acceptable 17-inch monitor? For buyers who want adequate performance at the lowest price, we suggest you look at the Amax Impression7 (it has an $899 list price) and AOC CM-747 (with its $999 list price). Each of these sells for $800 to $900 on the street. Note, however, that for only a few dollars more, you can buy one of our Editors' Choice monitors: the Sony CPD-1730.

The Samtron SC-726V and Sceptre CL-617 are otherwise acceptable performers but lack the MPR II compliance that indicates a low-emissions monitor.

The final eight monitors we tested are low-quality, and because they don't compare favorably to the other units we tested, we feel they don't merit recommendation; these are the monitors offered by Amdek, AST, KFC, Philips, Relisys, Sampo, and Samsung.

that are not noticeable to the naked eye. Thus, test results within a particular range (0.1 mm to 0.7 mm, for example, on our pincushioning test) are good scores, and differences within that range would not be detectable by the eye. It is also important to recognize that monitor performance varies among units from the same manufacturer, and even within the same model.

Each test focuses on specific areas of the screen, although we have chosen areas where problems are most likely to show up: one inch from the upper-left-hand corner and one inch from the lower-right-hand corner, for example (except in the pincushioning tests).

The results of our subjective tests, which comprise bandwidth tests (seeking problems such as blooming, color shifts, image bounce, and muddy characters) and replications of the SuperSpot 100 procedures using only the human eye, are discussed in the reviews.

Test results are discussed in the "What the Numbers Mean" sidebar. We believe all but the lowest-scoring monitors will provide at least adequate performance for most users.

SUBJECTIVE TESTS

As mentioned earlier, our testing regimen included a set of subjective tests. That is, besides subjecting the monitors to objective testing procedures and equipment, we also subjected them to thorough evaluation by our authors. Each reviewer followed a test script that helped us determine what it would be like to live with these 17-inch high-resolution monitors. We connected each monitor to the same testbed used in the objective tests: a Northgate Slimline SP 433 with ISA-bus ATI Graphics Ultra Pro video cards and 2MB of video RAM.

Once the monitors were connected, we chose the Windows driver at 800 by 600 by 256 colors at 72 MHz and began testing under Windows 3.1. Using an Extron Inline meter, we verified that the monitors were running at a vertical refresh rate of 72 Hz. Then we opened a full-screen DOS session from within Windows 3.1. Using the Dir command, we obtained a full screen of text. We then used the Alt-Enter command to jump back to full-screen Windows 3.1, noticing

HIGHLIGHTS

17-Inch Monitors

FOR GRAPHICAL environments like Microsoft Windows and OS/2, 17-inch monitors are the right size, offering up to 1.5 times as much screen space and higher resolutions than do 14-inch models. You can find 17-inch monitors with reasonable list prices (the average ranges from $1,000 to $1,500), while 19- to 21-inch models remain more expensive (with average list prices ranging from $2,000 to $4,000).

THE 17-INCH MONITOR MARKET is still relatively small, constituting about 5 percent of the total U.S. monitor market. Of this market, 77 percent is composed of 14-inch models, and all larger-size monitors (19-, 20-, and 21-inch models) together make up 2 percent of the market. The remaining 16 percent are 13-, 15-, 16-inch, and other sizes. The number of 17-inch monitors being introduced is increasing.

AS THEIR POPULARITY RISES, pricing for 17-inch monitors is declining. You can find more than half of the 34 units for under $1,000 on the street, and several can be purchased for less than $900. Vendors are offering value-line models (such as Compaq, Nanao, and NEC) with fewer features and less functionality at lower prices. However, the highest-quality monitors (including our three Editors' Choices) typically are the highest priced.

NEW ENERGY-SAVING FEATURES power-down monitors in a series of steps when the devices are not in use. The first energy-saving 17-inch monitors have been introduced by Idek and Nanao, and their numbers will increase as this feature becomes de rigueur to meet new standards from VESA and the EPA's Energy Star program.

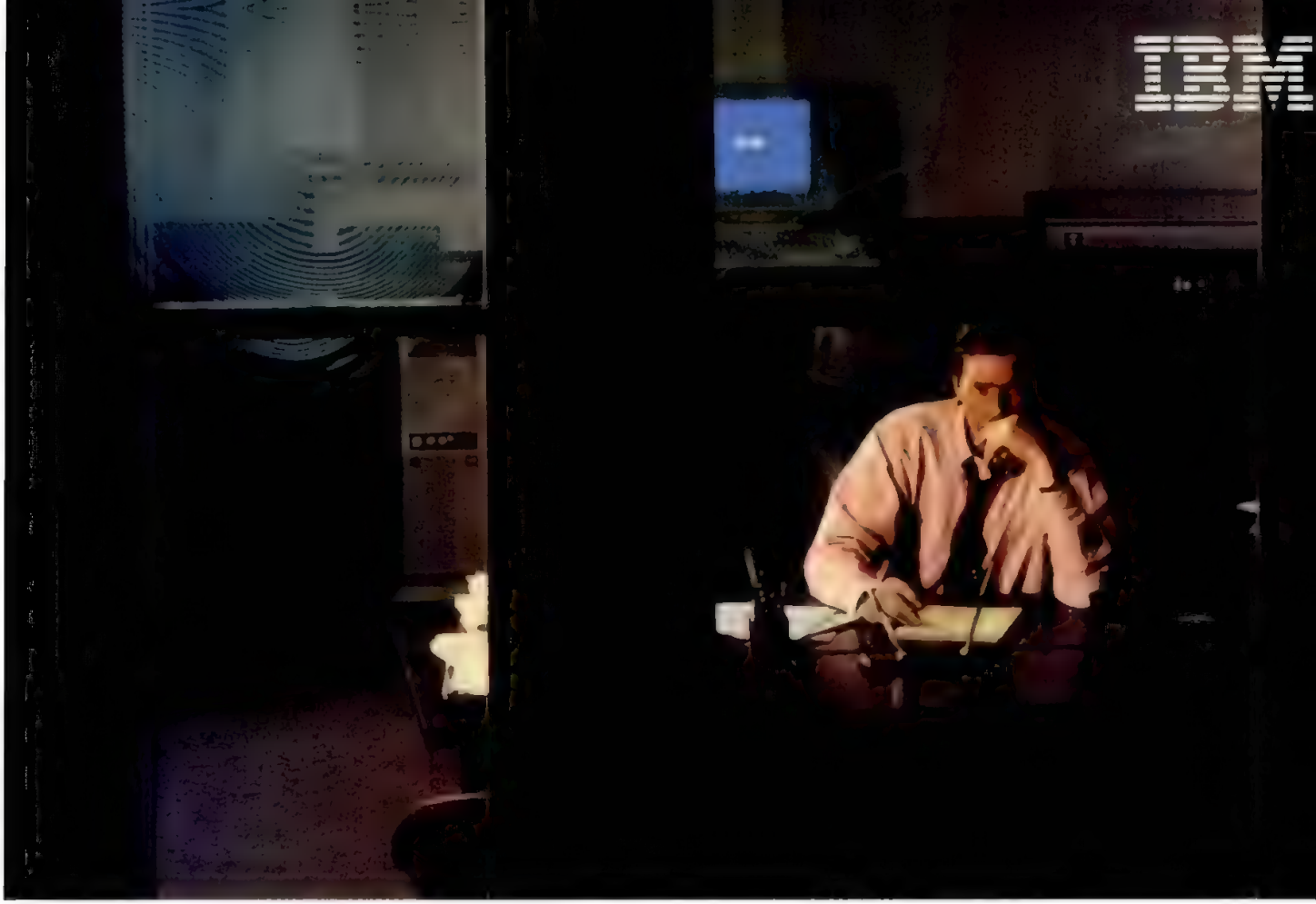
MPR II COMPLIANCE is also becoming universal. Manufacturers of 29 monitors in this review claim that their products comply with the Swedish MPR II emissions standards. Monitors from Amdek, KFC, Relisys, Samtron, and Sceptre did not meet the MPR II standard on our test, but these five companies did not claim that their products met this standard. MPR II test results for monitors in this review are presented graphically.

A HIGH REFRESH RATE and small dot pitch (0.28 mm or smaller) are desirable characteristics in a monitor. VESA recommends a vertical refresh rate of 70 Hz at 1,024-by-768 and 72 Hz at 800-by-600.

MICROPROCESSOR-DRIVEN digital controls, which allow for more flexible and accurate screen adjustments and custom settings, are becoming standard fare on 17-inch monitors. Controls are becoming more accessible and sophisticated (providing controls for pincushioning and convergence, for example). Only 3 of the 34 monitors in this review had only analog controls.

MULTISCANNING AND AUTOSIZING are becoming standard features. The first lets a monitor adjust automatically to a spectrum of signal frequencies from graphics adapters, and the latter lets the unit automatically resize a screen when switching between video modes (from DOS to Windows, for example). Support for a wide range of frequencies lets a monitor work with more adapter cards and at more resolutions.

COLOR MATCHING is showing up more on 17-inch monitors, chiefly in response to users' dissatisfaction with the inconsistency between the colors displayed on a monitor and those produced by a printer. Color matching offsets the differences in color tone between the display and printer. For this story, 13 offered color matching.



There was a time when your worst technical nightmare wouldn't go away till the morning after.

Aaron Matas
Product Support Specialist
IBM Personal Systems
HelpCenter

IBM Personal Systems HelpCenter® Product Support Specialist Aaron Matas knows from personal experience that emergencies don't keep bankers' hours. That's why our HelpCenter stays staffed and ready around the clock. So if a system goes down, you won't have to wait till sometime the next day to find out if it's your hardware, software, or who knows what. After all, it's just common sense that the company who sold you the system should be there for you when you need them. Whatever your question, experts like Aaron are wide awake and ready to help you get back in business. Fast. It's all part of IBM HelpWare®.

If you've ever bought computers "direct," we want you to know one important thing.

IBM PC Direct

We're putting the personal in personal computing.

This time, it can be different.

This time it's

L-R: Alice Robinson, Gregg McGhee, Jeff Herman and Beverly Whitman, Custom Build Technicians, IBM Personal Computer Company

425SX/S

433DX/D

466DX2/T

ValuePoint SpaceSaver

- Compact size: 14.2" W x 4.8" H x 16.5" D
- 3 slots (includes 1 VESA Local Bus slot!) and 3 bays
- Also available in medialess (no drives) configuration to function as an economical LAN client workstation!

ValuePoint Desktop

- Plenty of room to grow: 5 slots (includes 1 VESA Local Bus slot!), 5 bays
- A super combination of speed, power, upgradability and expandability!

ValuePoint Mini-Tower

- Convenient, compact Mini-Tower processor case measures 9.5" W x 16.8" H x 16.9" D
- Enormous room for growth: 8 slots (includes 1 VESA Local Bus slot!), 6 bays
- Perfect format for high powered computing (CAD/CAM, graphics, multimedia, etc.) or as a low-cost network server!

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If you don't see it here, call us. We'll custom build a system just for you.

It's a personal commitment from Alice, Gregg, Jeff, Beverly and their associates at the IBM Personal Computer Company. Thousands of IBM people – many working around the clock – to keep you personally delighted with everything we do for you.

It starts – but doesn't end with – our hot-selling IBM ValuePoint™ PCs. Take a closer look at the systems shown here. Super PCs. Super prices. But if you don't see the system you want, call us. We'll build your PCs to your specifications – and your budget.

Remember, ValuePoint is backed by IBM HelpWare, including our 30-day moneyback guarantee. No qualms. No quibbles. No questions asked.[1] And for 1 year with free around-the-clock telephone assistance and fast onsite service (even in the most remote locations!) from more than 10,000 IBM service representatives in over 1,600 locations nationwide.[2]

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intel inside

All ValuePoint systems feature:

- 101-key IBM Enhanced Keyboard and IBM Mouse
- Intel® i486™ processors
- SVGA VESA Local Bus Video
- A 32-bit VESA Local Bus slot for local bus speed on SCSI drives and other peripherals!
- IBM HelpWare
- Upgradability via Intel OverDrive™ technology all the way up to Pentium™[3]
- Zero Insertion Force (ZIF) socket for fast, easy processor upgrades.

ValuePoint SpaceSaver	425SX/S	433SX/S	433DX/S	433DX/S
Processor	i486SX/25 MHz	i486SX/33 MHz	i486DX/33 MHz	i486DX/33 MHz
Hard Drive/Memory	120MB/4MB	120MB/4MB	120MB /4MB	245MB/8MB
Diskette	3.5"	3.5"	3.5"	3.5"
Display	6312 14" SVGA NI	6312 14" SVGA NI	6312 14" SVGA NI	6314 14" SVGA NI
Operating System	IBM DOS & WINDOWS™	IBM DOS & WINDOWS	IBM DOS & WINDOWS	OS/2®
Price* / IBM Credit Lease**	**$1,579** / $57 per month	**$1,779** / $64 per month	**$2,029** / $73 per month	**$2,469** / $89 per month

ValuePoint Desktop	425SX/D	433SX/D	433DX/D	466DX2/D
Processor	i486SX/25 MHz	i486SX/33 MHz	i486DX/33 MHz	i486DX2/66 MHz
Hard Drive/Memory	120MB/4MB	120MB /4MB	120MB/4MB	245MB/4MB
Diskette	3.5"	3.5"	3.5"	3.5"
Display	6312 14" SVGA NI	6312 14" SVGA NI	6312 14" SVGA NI	6312 14" SVGA NI
Operating System	IBM DOS & WINDOWS	IBM DOS & WINDOWS	IBM DOS & WINDOWS	IBM DOS & WINDOWS
Price* / IBM Credit Lease**	**$1,659** / $60 per month	**$1,859** / $67 per month	**$2,099** / $76 per month	**$2,779** / $100 per month

ValuePoint Mini-Tower	433DX/T	466DX2/T	466DX2/T	466DX2/T
Processor	i486DX/33 MHz	i486DX2/66 MHz	i486DX2/66 MHz	i486DX2/66 MHz
Hard Drive/Memory	340MB/4MB	527MB/4MB	527MB/4MB	527MB/8MB
Diskette	3.5"	3.5" & 5.25"	3.5"	3.5"
Display	6318 14" SVGA NI	6318 14" SVGA NI	6319 15" SVGA FS NI	6319 15" SVGA FS NI
Operating System	IBM DOS & WINDOWS	IBM DOS & WINDOWS	IBM DOS & WINDOWS	OS/2
Price* / IBM Credit Lease**	**$2,579** / $93 per month	**$3,499** / $126 per month	**$3,599** / $130 per month	**$3,789** / $137 per month

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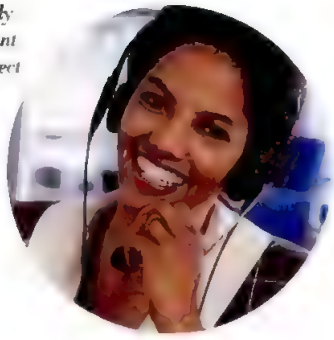
Angela Hardy
PC Consultant
IBM PC Direct



It's as simple as calling Angela Hardy, or any one of our other PC consultants. ValuePoint PCs, ThinkPad® notebooks, peripherals, printers, displays, add-ons, the most popular software and more (IBM and non-IBM) are all yours – at prices you'll find personally pleasing – when you call 1 800 IBM-2YOU. You'll speak to a PC consultant who'll either answer any question you have, or get you in touch fast with an expert who can. If you don't see it here, it's in our free catalog. And if it's not in the catalog, we can probably get it for you anyway. Either way_call!

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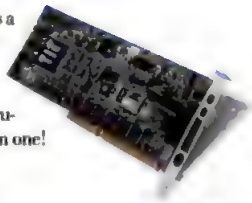
The Mwave™ WindSurfer™ Communications Adapter is a V.32 Data Modem, 9600 bps Fax/Modem and CD-quality sound system. Mwave MIDI synthesizer with instruments *and* MIDI port...all in one!



Mwave WindSurfer Communications Adapter (92F4057) $349

Eliminate LAN processing bottlenecks!

The IBM LAN Streamer MC 32 Adapter can help you increase your network's capacity and set new standards for speed and performance! No new hardware or costly facility rewiring. Streams frames directly between system memory and Token-Ring without storing them directly in adapter.

LAN Streamer MC 32 Adapter (92F8942) $859

Give your PC gigantic storage capacity!

This 3.5" Rewritable Optical Drive lets you put all your large-project files on one 127MB optical disk. You can store this disk in your desk, and free up precious hard drive space! Update data when you want, use the disk over and over.

IBM Enhanced 3.5" Rewritable Optical Drive (6451295) $1,499
SCSI External Enclosure (35H00V0) $219

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The ISA Internal CD-ROM has a fast 300KB/SEC maximum data transfer rate – double the speed of most CD-ROM drives! You can load your operating system and applications software from a typical 600MB CD-ROM disk. You save precious hard drive space and load onto your ISA system faster. It's priced to move fast too!

IBM ISA Internal CD-ROM Drive (32G2961) $315

Upgrade to 256KB L2 Write Back Cache Memory.

Here's a super way to boost system performance without buying a new system. This 256KB L2 Write Back Cache Memory Kit gives you an easy, standardized growth path for your ValuePoint systems

256KB L2 Cache Write Back Memory Kit (60G1626) $249
Cache Memory Kit 256KB (60G1625) $229
Cache Memory Kit 128KB (60G1624) $119
IBM Video Memory Upgrade Kit (60G1623) $89

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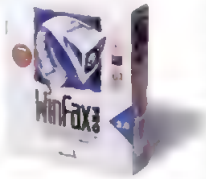

WinFax™ Pro (MM13632) $79
STACKER® (MM29205) . . $95
Quicken™ for Windows 2.0 (MM45870) $45
WordPerfect® for Windows 5.2
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any errors, sync problems, or problems with screen bounce. We repeatedly jumped between full-screen DOS and Windows 3.1 to test this monitor characteristic.

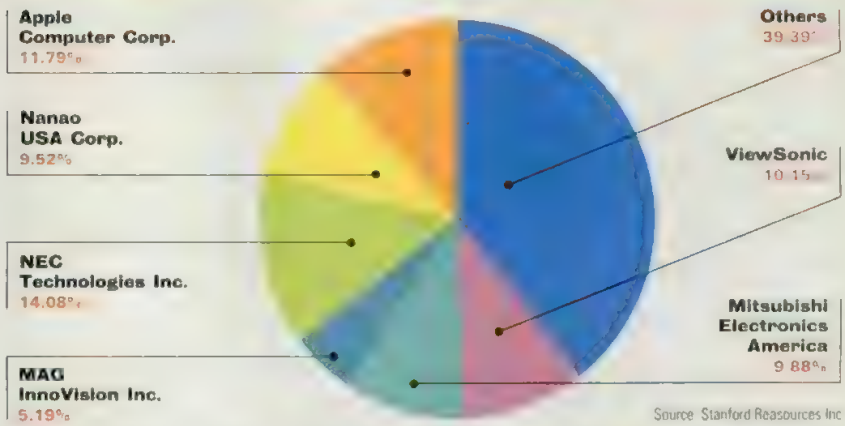
Afterwards, we ran special testing software called Montest, with which we visually inspected the monitors for convergence problems, paying special attention to the corners and centers of the screens. These subjective evaluations served as validity checks for the objective tests we had already finished. We also noted the effect that a monitor's controls had on any perceived misconvergence.

After checking for misconvergence, we opened the Windows Notepad from the Accessories menu and loaded a special file that let us visually check a monitor's ability to display a page full of characters. We noted whether the display became muddy and if we could spot the white background within and between characters. We also noted any sign of definition loss, which would indicate a monitor's inability to handle a signal (a bandwidth limitation, in effect).

After performing these tests at 800-by-600 resolution, we repeated them using the noninterlaced ATI driver for 1,024-by-768 with 256 colors at 70 Hz. If a monitor claimed a refresh rate higher than 70 Hz, we tested at that level also. Finally, we checked to see whether the monitor could work at a resolution of 1,280-by-1,024 with 256 colors. Although 1,024-by-768 and 800-by-600 modes are the optimal resolution for a 17-inch monitor (characters are too small at higher resolutions), the ability to run 1,280-by-1,024 mode at a high refresh rate is an indicator of its potential.

The results of our subjective and objective tests are discussed and analyzed in the individual reviews following this introduction.

17-Inch Color Monitor Market (First Quarter 1993)



Source: Stanford Reasources Inc

This chart shows the six U.S. market leaders, by unit sales, in the 17-inch color monitor arena. Seventeen-inch monitors made up about 5 percent of all color monitors shipped in the U.S. in the first quarter of 1993 (154,000 out of 2.63 million units).

REFRESH RATE AND DOT PITCH

In evaluating monitors, you should pay attention to their vertical refresh rate and dot pitch. These numbers can help you avoid grainy graphics and screen flicker. Monitors and graphics adapters speak to each other mainly in terms of frequencies. A graphics card sends out horizontal and vertical sync signals to the display. A monitor's electron guns draw screen pictures one horizontal line at a time, from left to right. The guns must make several hundred horizontal passes for every frame (640 for VGA, 800 for SVGA, and so on). The number of frames the monitor draws per second is called the frame rate, *vertical refresh* rate, or vertical scanning frequency.

Because many horizontal cycles must be completed before even one vertical cycle is done, horizontal frequency is described in kilohertz (kHz), while vertical frequency is expressed in hertz (Hz).

Dot pitch refers to the space between the individual dots or picture elements (pixels) that make up the screen. A high dot pitch produces a grainy, less focused image, while a lower dot pitch produces a sharper image. In general, our tests found that you should not consider a dot pitch larger than 0.28 mm; 0.25 mm is preferable. (The accompanying features table shows the dot pitch for the monitors in this roundup.)

An exception is the Sony Trinitron picture tube, which does not have a dot pitch per se. Instead of using the shadow mask that other monitors use, the Trinitron-based monitors incorporate a stripe mask, or aperture grill. This serves the same function as a shadow mask, providing a screen through which the electron gun can more precisely strike the phosphors. But it is constructed with thin wires that run only the length, not the width, of the screen, thus creating stripes rather than holes. The space between these stripes is sometimes mistakenly referred to as the dot pitch. Five of the units we tested used Trinitron technology—the E-Machines ColorPage T16 II, the Philips 1762DT FastRefresh/17, the Seiko CM1760LR, the Sigma Designs Ergo View 17, and the Sony CPD-1730—which had admirably small aperture-grill pitches of 0.25 mm.

Even the smallest dot pitch, however, will not eliminate the annoyance of a flickering or flashing monitor. Screen flicker results from a slow screen refresh rate or the use of interlacing. *Interlacing* refreshes every other line of the screen in one pass and then redraws the remaining lines in a second pass. Interlacing is used to save money, but your optical cortex will perceive this subtlety and note it as flicker. Severe monitor flicker can be the source of eyestrain, headaches, and fatigue.

The easiest way to avoid screen flicker is to buy a noninterlaced monitor with a high vertical refresh rate and pair it with

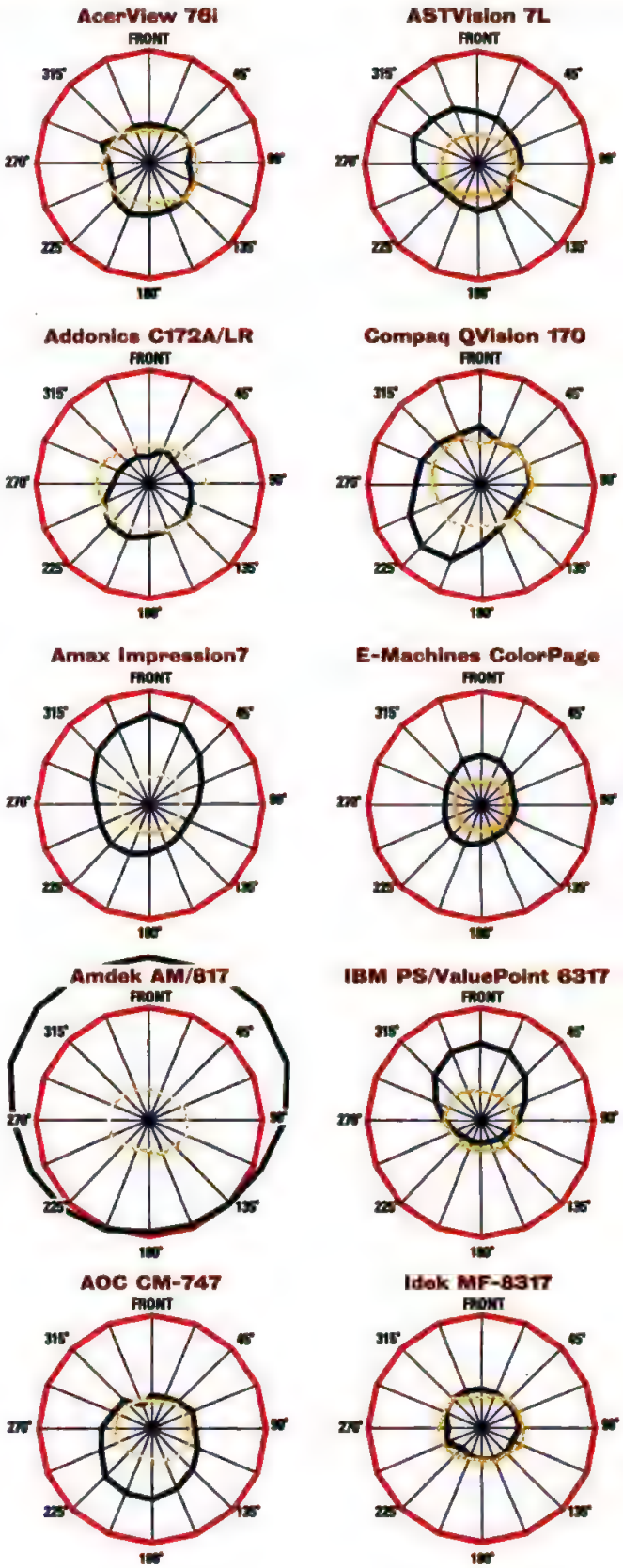
Our Contributors: BRUCE BROWN and JOHN R. QUAIN are contributing editors, and BRAD STILWELL is an editorial researcher at *PC Magazine*. DON CRABB is director of laboratories and a senior lecturer at the University of Chicago. MICHAEL NEUBARTH was the associate editor in charge of this story, and JONATHAN HILL was the project leader.

ELF and VLF Emissions Testing

Only five of the tested monitors—none of which claimed MPR II compliance—fell outside of the MPR II guidelines for VLF emissions: the Amdek AM/817, the KFC CA 1713, the Relysis RE-1764, the Samtron SC-726V, and the Sceptre CL-617. One additional unit, the Samsung SyncMaster 4 Plus, was on the border of the MPR II guideline for VLF radiation. All 34 monitors met the MPR II guidelines for ELF emissions.

How We Tested: Emissions

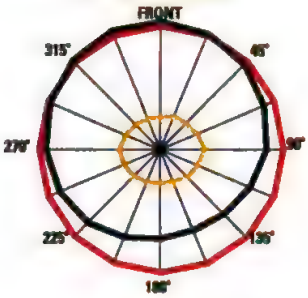
All of the monitors in this review were tested for compliance to a subset of the Swedish government's MPR II electromagnetic emissions standards. We measured magnetic field emissions in the extremely low frequency range (ELF, 5 Hz to 2 kHz) using Combinova MFM 10 meters, and in the very low frequency range (VLF, 2 kHz to 400 kHz) using Combinova MFM 1000 meters at 16 points spaced evenly around each monitor at a radius of 0.5 meters. Those monitors that emitted less radiation than the limits of the MPR II guidelines (250 nT [nanoteslas] for ELF emissions, and 25 nT for VLF emissions) are considered to have passed our tests. Please note that neither PC Magazine Labs nor ZD Labs is a formal MPR II testing facility. Thus, while these results accurately reflect ELF and VLF emissions levels, we can neither grant nor deny MPR II compliance to a monitor. The results have been normalized to the ELF and VLF guidelines, respectively, in order to present both ELF and VLF findings in a single "radar" graph. Thus, the MPR II guideline boundary represents 25 nT for the VLF and 250 nT for the ELF. Results lying entirely within the red boundary are considered to have passed the tests. Where we reviewed pairs of monitors (Nanao, NEC, Sony, ViewSonic), only the emissions graph for the higher-end model is shown.



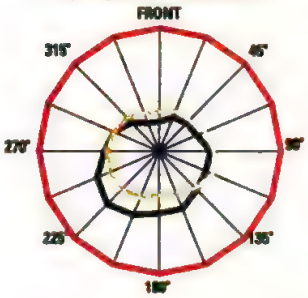
Relative radiation levels

- **MPR II guidelines**
- **ELF emissions** (relative to 250 nT maximum)
- **VLF emissions** (relative to 25 nT maximum)

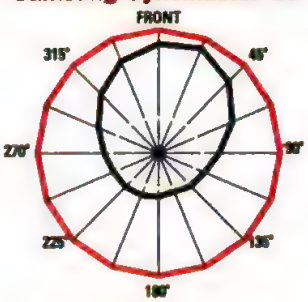
KFC CA 1713



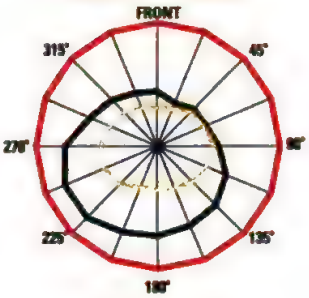
Optiquest 4000DC



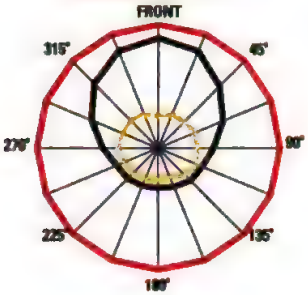
Samsung SyncMaster 5c



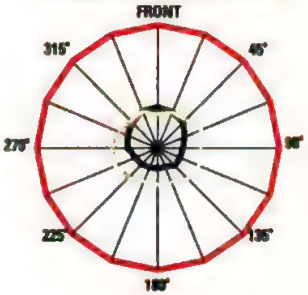
Sony CPD-1730



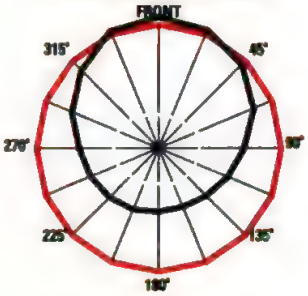
Liberty CL-9117



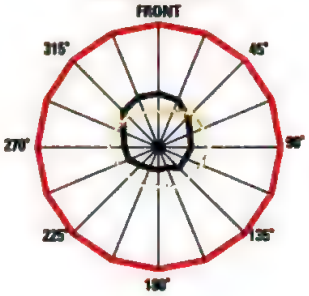
PanaSync/Pro C1795E



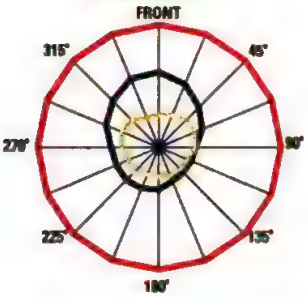
Samtron SC-726V



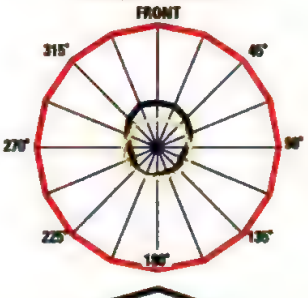
Swan 17LR



MAG MX17F



Philips 1762DT



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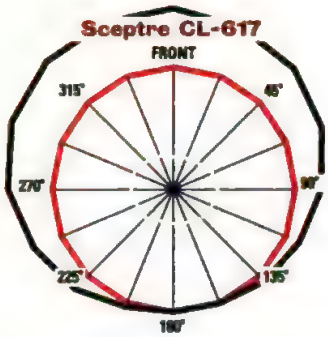

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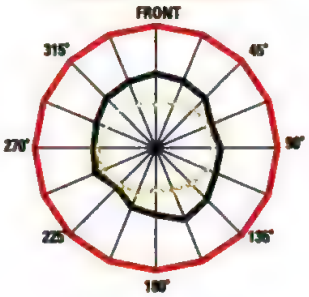
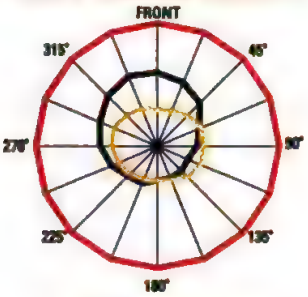
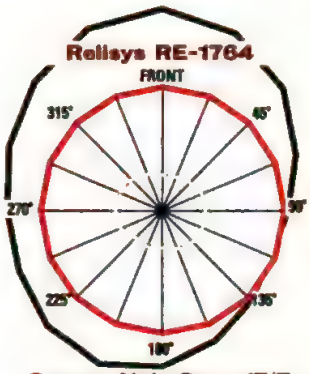


Nanao Flexscan F550i-W



Relisys RE-1764



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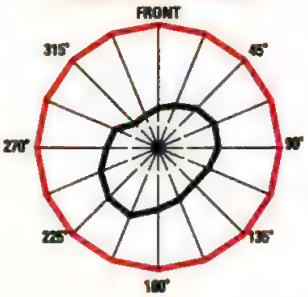
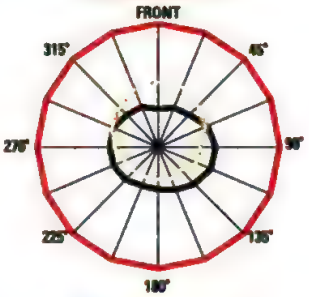
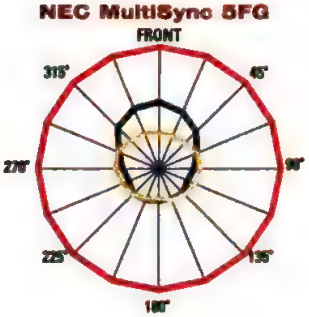


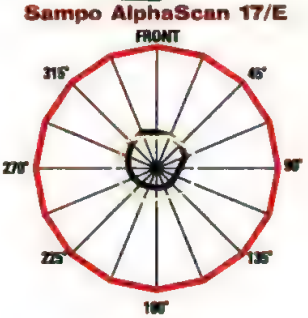
ViewSonic 17



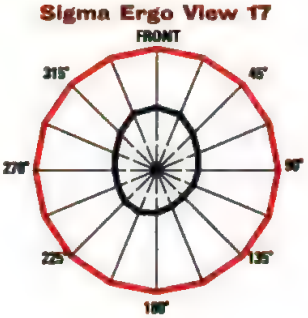
NEC MultiSync 5FG



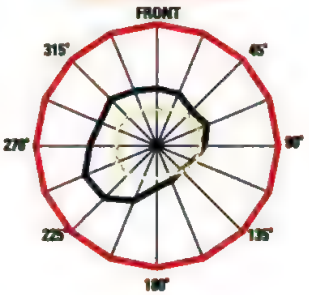
Sampo AlphaScan 17/E



Sigma Ergo View 17



ZDS ZCM-1790



a video card capable of the same refresh rate. A vertical refresh rate of 70 Hz and higher nearly guarantees a flicker-free screen, even under the harsh fluorescent lights found in many offices. Some older video-adapter cards scan only as high as 60 Hz. While this may prove fine for 640-by-480 resolution, it will create serious flicker at higher resolutions like 1,024 by 768. As you upgrade to a 17-inch monitor, therefore, you may also have to upgrade your video-adapter card.

Ever since monitor ergonomics became an important issue, VESA (Video Electronics Standards Association) has been providing recommended monitor vertical refresh rates. For 640-by-480 and 800-by-600 resolutions, VESA has standardized on a 72-Hz refresh rate, while for 1,024-by-768 resolutions, it has standardized on 70 Hz. VESA also contends that there are some people who are unaffected by flicker in SVGA and 1,024-by-768 modes at 60 Hz. But it maintains this 60-Hz refresh rate only as a minimum guideline (we recommend the higher 70-Hz and 72-Hz levels).

A color monitor with a vertical scanning range of 48 Hz to 79 Hz and a horizontal range of 28 KHz to 60 KHz offers a comfortable combination of backward compatibility for an old video card and current compatibility for a new one. If you want a monitor with a stretched-out life, be sure to buy one with a broad range of scanning frequencies—say, a 45-Hz to 105-Hz vertical and 18-KHz to 80-KHz horizontal refresh rate.

MULTISCANNING AND AUTOSIZING

Almost all large-size monitors offer *multiscanning,* which lets them adjust (or sync) to different signals broadcast from graphics adapters—provided those signals fall into a monitor's scanning range, or bandwidth. NEC markets its line of multiscanning monitors under the MultiSync trademark. Another name for multiscanning is autosyncing.

A sync/signal combination is composed of a horizontal and vertical scanning frequency. Choose a monitor with variable-frequency multiscanning; the more frequency combinations a monitor supports, the more video cards it can work with and the more resolution modes it can offer. Be aware that manufacturers use different terms to denote multiscanning capability; a monitor labeled only "multiple-frequency" might be capable of working with only a limited number of fixed-frequency combinations.

Another feature, often confused with multiscanning, is *autosizing.* While multiscanning adjusts to different signals, autosizing adjusts to changes in screen size. For example, the screen size might change when you switch from 1,024-by-768 resolution in Windows to the DOS prompt. Without autosizing, you may have to adjust the picture manually when such changes occur. This is a pain for users who work in multiple video modes, environments, and applications.

A vertical refresh rate of 70 Hz and higher nearly ensures a flicker-free screen—even under harsh fluorescent lights.

Autosizing maintains a smooth and constant screen setting when you change between these modes. Monitors that use autosizing may rely on an internal set of predefined settings for certain video modes and may also accept user-defined presets in memory for custom settings.

True autosizing means that a monitor can maintain a constant image size no matter what resolution the graphics adapter dictates. In reality, 17-inch monitors do not offer true autosizing, since no VESA standards exist for it at some screen resolutions. Instead, they offer fixed-setting autosizing. How a monitor handles user-defined presets—and how many custom options are available—can mean the difference between a monitor that adjusts itself and one that requires continual tweaking.

MONITOR CONTROLS

Display tuning also takes on new meaning in the 17-inch-monitor world. Although a 14-inch monitor usually comes with a power switch and two controls for brightness and contrast, larger monitors boast sophisticated tuning capabilities. Forget about reaching around the back to find the contrast knob, or getting out a flat screwdriver to position the screen. Most 17-inch monitors put a wide range of controls at your fingertips, often in convenient front-mounted panels (some units offer slide-out or pull-down drawers).

All of the monitors here provide brightness, contrast, and four basic image controls (horizontal and vertical size and position). Some also let you control pincushioning and keystoning as well as focus. Some even provide an external control for convergence (although manufacturers tend to leave that control inside the case for service technicians to adjust). Most of the monitors also offer degaussing controls to help return color purity (if you happen to place, say, a giant bar magnet next to your monitor or an unshielded speaker next to it when hooking up a multimedia system).

Pincushioning is seen as an inward or outward bowing of the image along the screen's edges—a kind of hourglass effect. (Outward bowing is also called *barrel distortion.*) Almost every monitor of any size exhibits some degree of pincushioning, and pincushioning controls help in fine-tuning the image.

Convergence is the measure of how well a monitor's red, blue, and green electron guns produce clean, crisp colors (especially white). To do this well, the beams must overlap precisely. Inaccuracy results in colored halos around images. A convergence control lets you alter the alignment of the guns for the best possible screen color.

On tested monitors, the controls were arrayed on the front panel. More important than the location of the control panel, however, are the types of controls. For the most part, controls have evolved from analog (knobs) to digital (buttons), which are easier to use and more accurate. Some recent models also provide on-screen menus and graphs as part of their controls.

Most 17-inch models let you widen or reduce the screen area vertically and horizontally or reposition the entire screen, allowing you to create huge blowups. With the best 17-inch monitors here, you can define preset conditions for applications such as Windows. Moreover,

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	ViewSonic 15	ViewSonic 17	ViewSonic 20	ViewSonic 21
Screen Size	15"	17"	20"	21"
Dot Pitch (mm)	0.28	0.27	0.28	0.25
Horizontal Frequency (KHz)	30-64	30-82	30-82	30-82
1600 x 1280 Non-Interlaced		■	■	■
Maximum Refresh Rate (Hz) at 1280 x 1024 NI	60	76	76	76
Flat Square Screen	■	■		■
ViewMatch™ Color Control	■	■	■	■
Low Radiation (MPRII)	■*	■	■	■
Suggested List	$635	$1,299	$2,099	$2,399

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ViewSonic 21 screen image by SPATIEL TECHNOLOGY INC., Boulder, CO. Created with ACIS® Geometric Modeler and rendered with Visualization Husk.

*Color temperature select 9300°K or 6550°K only

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you may also choose (in addition to screen size and position) a particular color refreshment and predefined screen realignment.

Part of the reason large monitors use such sophisticated tuning capabilities relates to their large, complex picture tubes. Such high tuning is unnecessary with most 14-inch units, since they are limited to a maximum displayable area. Most 17-inchers can display images that stretch beyond the line where the glass meets the casing. Since they have screens that are generally flatter at the edges than those of most 14-inch monitors, 17-inch displays are well suited to stretching images.

Most of the monitors here also provide internal microprocessors and memory. With this technology, a monitor has the ability to store a number of image settings for a variety of graphics display modes. Only the Relisys RE-1764, the Sampo AlphaScan 17/E, the Samsung SyncMaster 4 Plus, the Samsung SyncMaster 5c, the Samtron SC-726V, and the Seiko CM1760LR lacked some kind of control memory.

Monitors that lack the memory and multiple settings of the fancier units often include preprogrammed image settings for the most popular resolutions. If your graphics card supports one of these popular modes, a monitor will switch to that setting automatically and will display an almost perfectly sized and positioned image. If a monitor lacks such preprogrammed image settings, it will usually have blank memory slots into which you can program your own settings or reprogram the factory presets. With most 17-inch monitors, you can play with the controls until the image is perfect, save it, and never have to meddle with it again.

COLOR MATCHING

Thirteen of the 34 monitors in this roundup incorporate color matching. This feature was developed in response to the rising popularity of color printing and the subsequent complaints by users that colors being displayed on their monitors were not the same as the colors being printed. Color matching lets you adjust (via digital controls) the strength of the red, green, and blue electron beams so screen colors more closely match printed colors, regardless of the color-printing scheme (CMYK, Pantone, and so on) being used. Users should be aware, however, that although color-matching technology is an improvement, its precision is still variable.

ENERGY AND ENVIRONMENT

Another feature that is certain to gain widespread acceptance is the energy-

Big Monitors: *The Market Picture*

by Brad Stilwell

While most PC users would love to have a large color monitor on their desks (19-inch, 20-inch, 21-inch, and larger models), they generally are held back by price. Most 21-inch monitors range from $2,000 to $3,000, which is more than many users pay for their entire system.

Slightly smaller, 19- and 20-inch monitors, with street prices from $1,500 to $2,500, also are beyond many users' budgets.Some users even find 17-inch monitors, which are selling for $800 to $1,500 on the street, too pricey.

The largest percentage of monitors sold in the U.S. during the first quarter of 1993 had street prices from $175 to $350 (44 percent), according to Monitrak, a quarterly monitor-market report published by Stanford Resources, in San Jose, California.

The vast majority of all monitors shipped in the first quarter of 1993 (76 percent) were 14-inch models, while high-end monitors (with street prices of $700 and above) accounted for only about 10 percent of the total U.S. market. Monitors with street prices above $1,050 made up only about 5 percent of the total U.S. market in the first quarter of 1993, Monitrak reports.

The high prices of 19-inch and larger monitors are related to the high cost of manufacturing them. The larger a monitor's tube size, the more difficult it is to control the electron guns accurately. The engineering cost and higher-quality components required to accomplish this accuracy add considerably to the price of large monitors.

A high-resolution 26-inch monitor such as the Mitsubishi Diamond Pro 26H Color Monitor carries a $13,000 list price. This specialty monitor is expensive because of the precision required to manufacture its CRT, which also results in very low factory yield rates.

There certainly is a market for large displays, but it is primarily limited to CAD (computer-aided design) users, who require a larger screen area, and other niche users (such as those in advertising and desktop publishing), whose jobs dictate working with page layouts and high-resolution graphics (1,280-by-1,024 and beyond). These monitors can also be used for animation, mapping, and scientific visualization—designing DNA models, for example.

There also is a market for lower-cost, 19-inch monochrome monitors ($500 to $900 on the street), which are used for viewing X rays and document images. Sigma Designs and Wyse Technology are key suppliers for this niche area.

Only about 47,000 of the 2.6 million color monitors sold during the first quarter of 1993 were 19-inch or larger models, according to Monitrak. Of the large-size monitors shipped, more than one-third were made by Mitsubishi Electronics America. One of the handful of major CRT manufacturers, Mitsubishi offers the broadest range of large monitors, including four 20-inch workstation models and two 37-inch presentation displays (currently the largest monitors on the market).

NEC Technologies is also among the leaders of the large-monitor market, with its 21-inch NEC MultiSync 6FG and 27-inch NEC MultiSync 3PG. Other

saving capability currently being promoted by the Environmental Protection Agency (EPA) in its Energy Star program. To qualify as Energy Star–compliant, monitors must be able to power down to below 30 watts when not in use.

In addition, VESA is providing specs that will serve as guidelines for manufacturers to provide power-down features. The VESA spec will standardize a method that will allow monitors to both power down in steps as well as sense their vertical and horizontal scanning rates. The VESA spec will address four monitor modes: On, Standby, Suspend, and Off.

Nanao and Idek/Iiyama North America are among the first monitor vendors to provide power-down features, and more manufacturers will most likely follow suit.

FLAT SCREENS

Flat-screen technology is becoming pervasive among larger monitors. A flat screen produces less glare, which makes images rendered up to its edges significantly easier to view. Rounded screens, however, are much cheaper and easier to produce.

Trinitron tubes are flat in the vertical and curved on the horizontal, while true flat tubes (flat-square tubes) are flat on all sides. The newer flat-square tubes have only minor curves. In contrast, most older CRTs have a curved screen area, a setup that lets the electron guns easily maintain a perpendicular targeting area at all points on-screen. Flat-square screen technology has gained increasing popularity in the 17-inch-monitor market, and most monitors here use it.

Regardless of their type, flat screens are not entirely free of glare, though. If your office is particularly prone to glare from bright overhead lighting, consider a 17-inch monitor that has a special no-glare coating and a very flat screen. A factory-applied silica coating dramatically reduces glare, and in some cases also helps both block electromagnetic radiation and absorb static. NEC sells add-on glare panels for its monitors.

Still, don't automatically reject a monitor that doesn't have antiglare protection. After all, the flatness of the screen may be enough to prevent annoying glare. There also are a number of third-party antiglare products you can affix to your monitor to cut glare, static, and even ELF and VLF radiation.

After purchasing a 17-inch monitor, you should thoroughly test it; most graphics adapters and PC-system disks include some kind of monitor-testing routine. Look for image anomalies such as shoddy focus, which may indicate that the electron guns were damaged during shipping.

HOOKING IT UP

Unlike the average 14-inch display, a 17-inch monitor may offer several cabling choices. To connect to current graphics adapters, a monitor should always provide a standard 15-pin connector and perhaps a DB-9 (EGA) connector. Some monitors furnish an additional 15-pin connector for Macintosh or Unix compatibility and even plugs for a coaxial BNC connection.

In general, BNC connections are expensive features. They split the video signal into separate parts—such as horizontal and vertical, and red/green/blue (RGB) scans—which are transmitted via three to five separate coaxial cables at the back of the monitor. Coaxial BNC connectors offer the highest available RGB picture quality and a maximum of flexibility for accepting signals from different sources.

This type of connection is intended mainly for adapters that scan above 70 Hz. But having such an option available is important if you're making a long-term buy, if you have an interest in sophisticated design, or if you want to use the display with high-end display adapters in an office with Unix workstations.

If your office environment includes Macs, PCs, and Unix boxes, or if you plan

vendors with a presence in this market are Hitachi/Nissei Sangyo America, Ikegami Electronics, Radius, and Sony Electronics. IBM Corp., MAG Inno-Vision, Nanao USA Corp., and ViewSonic also have recently released 19- to 21-inch models.

Recent technological advances for large monitors include enhanced flat square CRTs, factory-applied antiglare coatings, and more intelligent controls. Flat square CRTs reduce glare and increase visual acuity. Mitsubishi's new generation of less expensive, more compact, flat-square-CRT units will also offer an improved antiglare coating.

Another significant development in the large-monitor market is Mitsubishi's purchase of Sony's CRT technology. Mitsubishi is developing a new CRT that combines the benefits of its Dynamic Beam Forming electron gun with Sony's Trinitron aperture grill and cylindrical base plate. The first monitor to incorporate the new CRT will be a 21-inch monitor slated for introduction by the end of 1993. The new CRT's design will reconcile the trade-off between image brightness and sharpness. By using Sony's technology, Mitsubishi is trying to attain higher levels of brightness without sacrificing the clear focus near the sides and corners of the tube.

Because large monitors are generally used at higher resolutions and require more fine-tuning, monitor manufacturers are positioning the controls on the front panels of large monitors (smaller monitors generally have some controls inside the case).

Energy-saving features that conform to the EPA's Energy Star standards are also being incorporated in large monitors. The new Idek/Iiyama monitors, for example, have an infrared body-heat sensor that automatically powers down the monitor from 160 watts to less than 5 watts after 30 minutes of nonuse. Nanao has also introduced a 21-inch monitor with power-down energy-saving features, and IBM is about to introduce an energy-saving 21-inch model.

Although large monitors are attracting more buyers, the near-term pricing outlook is not bright for consumers. With the dollar weak against the yen, U.S. monitor manufacturers are paying higher prices for CRTs produced in Japan and are therefore considering raising their monitor prices. At best, we will see only slight price decreases for large monitors in the near future. □

to move into sophisticated graphics, look for a monitor with as many connection options as possible. If you need only to connect the display to a standard graphics adapter, save money by picking a display without the costly BNC option. Some of the higher-end 17-inch monitors include the BNC capability as part of their list price, not as an option. We tested BNC connections on the four monitors that provided them. (See the accompanying features table for more information.)

GETTING SERVICE

What do you do if your hot new monitor breaks down? In the event of a malfunction, retail stores and mail-order houses generally act as middlemen between you and the monitor vendor. Most monitor manufacturers provide support in the form of warranties and telephone technical assistance.

Ask the vendor responsible for repairs where the unit will actually go and who will pay for shipping in each direction. If possible, try to get these facts in writing to avoid later mix-ups. Most vendors also provide telephone assistance for technical questions.

In addition, most monitor manufacturers have a bulletin-board service or an area on one of the on-line services (such as CompuServe and Prodigy) to handle inquiries, offer advice, and provide a forum for users of their products. Some monitor manufacturers are providing fax-back services as well.

PICKING A MONITOR

When shopping for 17-inch monitors, you should look at color quality, picture clarity, and brightness, as well as ergonomics, controls, and price. Pay careful attention to how a monitor is tilted on its built-in stand; make sure you are not craning your neck to view it. You may also want to consider ELF and VLF emissions.

To make certain a monitor meets your expectations, familiarize yourself with the factors that reveal a unit's image quality. Pay close attention to dot pitch, scanning frequencies, autosizing, digital tuning, and user-defined presets. Awareness of such details will help you find the monitor best-suited to your needs.

Also, make sure to pay attention to the reasons you need a monitor. For example, if you need vibrant color (or color matching) and crisp images for working primarily with illustrations, don't settle for anything less than the best-quality picture. If you're concerned mostly with business graphics or word processing, however, you may be able to drop your image-quality expectations down a notch or two.

BUYER'S CAVEATS

Ultimately, it's your hard-earned money that will buy that new 17-inch color high-resolution monitor, so now's the time to be picky—not later after you've bought the thing. To help you make a final purchasing decision, here's our list of caveats to keep in mind:

- No two monitors are alike—not even two products of the same model from the same manufacturer built one right after the other. You will always find some sample variability (as we did). The key is to learn how to discern the difference between sample variability and design variability. Look for flaws that are caused by sloppy manufacturing when buying a monitor in a store and insist on a new one if you discover any. But be very careful not to buy a monitor that has a flaw inherent in the design (such as poor or missing controls, an inferior stand, no glare coating, a high dot pitch, and so on). Such design flaws cannot be avoided by exchanging the monitor.
- If you buy from a store, open the monitor up, connect it to a machine and video card like your own, and check it out with sales and service help present. If you find flaws and problems at that time, insist on a new monitor. Never take the monitor with the promise that they will order you a new one.
- If you buy via mail order, make certain the mail-order company offers a 30-day money-back guarantee (no restocking charges, please) if the monitor turns out to be a turkey.
- Whether buying via mail order or from a store, be sure to protect yourself by always paying for your purchase with a charge card.
- Consider carefully the aesthetics of the monitor you want to buy. How will it look in your room or office? Also, consider the aesthetics of the image it produces. Compare its contrast, sharpness, brightness, and focus. Does the image please your eye? Can you make it pleasing by fiddling with the controls? Does it seem too harsh? Remember to keep in mind that the bottom line on monitors always comes down to a couple of simple characteristics: screen-redraw speed and image sharpness.

Because computer systems themselves are becoming so much cheaper, you can probably afford to put more of your computer budget into a 17-inch monitor. Consider that carefully before you settle on the 14-inch monitor that comes with the system you want to purchase. Some computer vendors are currently offering aggressive upgrade pricing if you opt for a display larger than the 14-inch models they typically bundle with their systems.

Acer America Corp.

AcerView 76i

BY DON CRABB

The AcerView 76i is a true variable-frequency multiscan monitor that lists for only $999. The improved 0.28-mm dot pitch makes the monitor better suited for detailed graphics work than its predecessor, the AcerView 76.

The 76i's tube, manufactured by Toshiba, has a conventional shadow mask attached to a flat-square screen. Picture quality was quite good in both 1,024-by-768 and 800-by-600 modes.

It was not as stellar on our MTF tests, posting an average score of 43 percent. It fared poorly on our misconvergence tests, with an average score 0.16 mm.

The monitor's control panel includes digital controls for color correction, pin-

AcerView 76i

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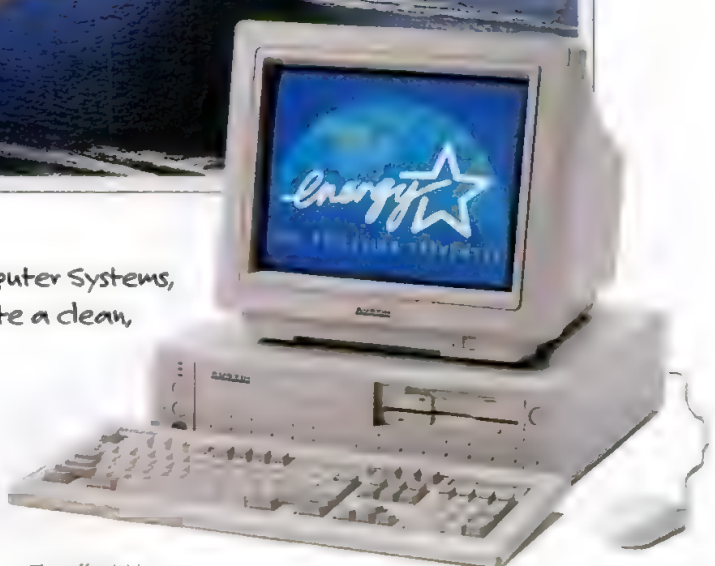

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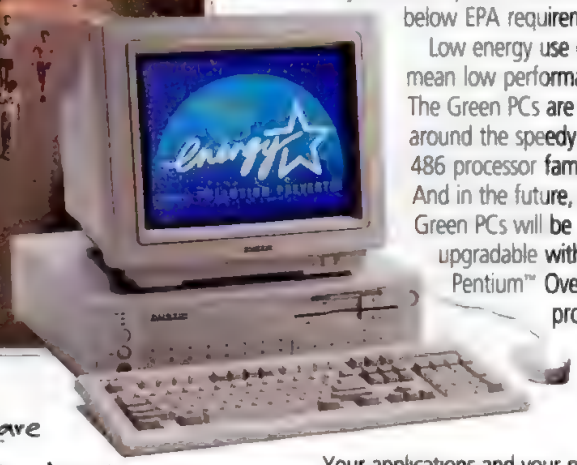

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cushioning, and keystoning, as well as 17 stored image-size settings and 21 user-definable modes. You can also recall your video board's factory default settings.

If your budget is tight, there's a lot to like in the 76i. For a low $999, it offers plenty of display room and good image quality, rendering it suitable for general-purpose work.

▶ FACT FILE

AcerView 76i

Acer America Corp., 2641 Orchard Pkwy., San Jose, CA 95134; 800-733-2237, 408-432-6200; fax, 408-922-2953.

List price: *$999.*

Circle 481 on reader service card

Addonics Technology Inc.

Addonics C172A/LR

BY DON CRABB

The picture quality of the Addonics C172A/LR ($995 list) was quite good for everyday applications such as word processing and database programs in both 1,024-by-768 and 800-by-600 modes.

The C172A/LR did well on our MTF tests, scoring an average rating of 47.5 percent, which was well above the mean score of 38.6 percent.

A poor showing, however, on our pincushioning tests (seventh from the bottom) was confirmed by our subjective evaluations. And while we could correct for the C172A/LR's tendency toward bad bowing at some resolutions by using its vertical-pincushioning control, there were many times when pincushioning was so severe as to be outside the control range of the external switches.

In sum, if you are willing to add antiglare protection and can live with the monitor's pincushioning problem, the Addonics C172A/LR could serve as a good general-purpose monitor, most appropriately used for noncritical graphics applications.

▶ FACT FILE

Addonics C172A/LR

Addonics Technology Inc., 30 W. Montague Express, San Jose, CA 95134; 408-944-0393; fax, 408-944-0392.

List price: *$995.*

Other models: *Addonics C171, $799; Addonics C172, $1,195.*

Circle 482 on reader service card

Addonics C172A/LR

Amax Impression7

Amax Engineering Corp.

Amax Impression7

BY BRUCE BROWN

You get good value for your money with the Amax Impression7 ($899 list). The Impression7 proved an above-average performer that presented us with no significant problems.

During testing, the Impression7 turned in above-average misconvergence and pincushioning scores, and it also garnered top honors (along with the ZDS monitor) on our MTF tests. When switching from partial to full-screen DOS windows, we noticed no bounce, shift, or flicker.

The Impression7 ran quite successfully at 76 Hz in 1,024-by-768 mode and at 70 Hz in 1,280-by-1,024 mode. Those numbers exceeded the monitor's rated maximum of 1,024 by 768 at 70 Hz and 1,280 by 1,024 at 60 Hz.

The Impression7's glare protection and controls are about average. The monitor lacks color controls, and its pincushioning control must be adjusted with a small screwdriver. The Impression7 passed the ELF and VLF standards for MPR II–compliance.

Better-than-average performance at a lower-than-average price sums up the Impression7.

▶ FACT FILE

Amax Impression7

Amax Engineering Corp., 3288 Laurelview Ct., Fremont, CA 94538; 800-888-6328, 510-651-8886; fax, 510-651-4119.

List price: *$899.*

Circle 483 on reader service card

Amdek Corp.

Amdek AM/817

BY BRUCE BROWN

The Amdek AM/817 ($1,139 list) garnered an average overall performance score. Its individual scores, however, are more telling.

Misconvergence-test performance was about average, and MTF and pincushioning results were below average. The monitor displayed severe pincushioning and offered no user-accessible controls to correct it.

Moire patterning was not very noticeable in 800-by-600 mode, but in 1,024-by-768 mode, we saw significant moire cross-hatching with vertical lines. The screen appeared rather muddy, with tight black-and-white character patterns. Also, the display clicked audibly and resized when shifting between

Amdek AM/817

full and partial DOS windows.

In DOS and Microsoft Windows in 1,024-by-768 resolution, the Amdek AM/817's 72-Hz refresh rate was fine. The monitor also performed quite well running in 1,280-by-1,024 mode at 70 Hz in Windows. The screen produced some flicker when running the same resolution at 60 Hz, however.

In sum, the AM/817 proved an average performer.

▶ FACT FILE

Amdek AM/817

Amdek Corp., a brand name of Wyse Technology Inc., 3471 N. 1st St., San Jose, CA 95134; 800-722-6335, 408-473-1200; fax, 800-742-6335.

List price: *$1,139.*

Circle 484 on reader service card

AOC International (USA) Ltd.

AOC CM-747

BY JOHN R. QUAIN

An attractive design and enough controls to keep the most fastidious user happy make the AOC CM-747 a standout in the 17-inch-monitor class. Although its performance was not spotless, its $999 list price ($800 street) is attractive.

During testing, the CM-747 earned an above-average maximum usable brightness score and a misconvergence score that landed in the top third of the group. It also ran well in noninterlaced 1,280-by-1,024 resolution at 74 Hz.

One of the CM-747's best features is the front flip-down control panel that makes adjusting colors as easy as adjusting the image on a TV set. Pincushioning and trapezoidal-distortion controls are included, in addition to a unique rotation control that corrects slightly skewed images. The only shortcoming is the monitor's inability to horizontally overscan.

AOC CM-747

The CM-747 is especially suitable for users seeking maximum flexibility and control at a minimum price.

▶ FACT FILE

AOC CM-747

AOC International (USA) Ltd., 311 Sinclair Frontage Rd., Milpitas, CA 95035; 800-343-5777, 408-956-1070; fax, 408-956-1516.

List price: *$999.*

Other models: *AOC CM-746, $849.*

Circle 485 on reader service card

AST Research Inc.

ASTVision 7L

BY DON CRABB

The ASTVision 7L ($995 list), which is built in Taiwan by Compal, provided a

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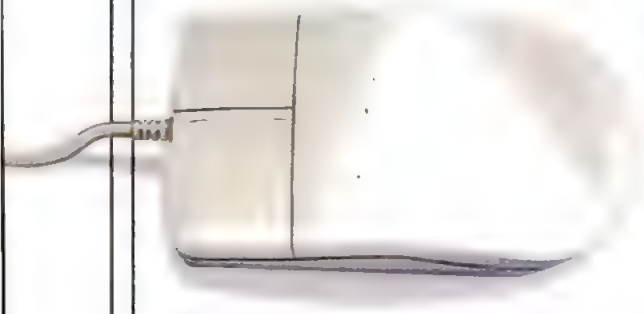

Some accounting tempt you with can be very

Find out if they truly offer a full Windows solution today. Or are they baiting you with a promise? Will it integrate with their DOS product? Is there an easy path to Windows? How much does it cost? Will you need retraining and new hardware? When will their product be available? A year from now? Two? Can you wait that long? Furthermore, have their systems been thoroughly tested?

Chances are, you'll discover the technology they're trying to lure you with has more holes than a hunk of Swiss cheese.

Truth is, only Macola Software brings you tomorrow's

mostly stable and clear picture at resolutions as high as 1,280-by-1,024. But the monitor suffered from serious misconvergence errors and insufficient brightness.

The ASTVision 7L showed poor performance on all but one of the tests we ran on these monitors, and a number of visual defects were noticed when the monitor was used for extended periods of time.

The ASTVision 7L did show exceptional performance on our pincushioning-error tests, however, achieving the second-best score of all the monitors in this roundup. That means the vertical and horizontal lines drawn by this monitor were very straight—a fact that was confirmed during subjective testing. Unfortunately, however, the unit's excellent pincushioning score was seriously compromised by its misconvergence problems.

The ASTVision 7L is a monitor that looks good at first glance, but the longer you stare at the images on its screen, the more you start to notice a number of defects. Because of its severe misconvergence errors, the ASTVision 7L is not a monitor you'll want to use for critical color applications.

ASTVision 7L

▶ FACT FILE

ASTVision 7L

AST Research Inc., 16215 Alton Pkwy., Irvine, CA 92718; 800-876-4278, 714-727-4141; fax, 714-727-9355.

List price: *$995.*

Circle 486 on reader service card

Compaq Computer Corp.

Compaq QVision 170 Color Monitor

BY BRUCE BROWN

The Compaq QVision 170 Color Monitor ($1,145 list) showed performance that makes it acceptable for most business uses.

A high MTF score, above-average pincushioning marks, average misconvergence scores, and a low brightness result gave the QVision 170 an average overall performance rating. There was some visible moire patterning in 1,024-by-768 mode. This was most noticeable in the screen corners, which were darker than the center of the screen.

While the QVision 170 is rated to run at 72 Hz in 1,024-by-768 mode and synchronized at that speed, its vertical adjustment was off; it ran better in 1,024-by-768 at 70 Hz. The monitor did not support 1,280-by-1,024 noninterlaced resolution but ran at 87 Hz in interlaced mode with only minimally observable flicker.

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Compaq QVision 170 Color Monitor

The QVision 170 has a fairly busy control panel, with two buttons each controlling horizontal and vertical size and position, brightness, and contrast. There are no color or pincushioning controls.

The QVision 170 is an adequate monitor with acceptable performance.

▶ FACT FILE

Compaq QVision 170 Color Monitor
Compaq Computer Corp., P.O. Box 692000, Houston, TX 77269-2000; 800-345-1518, 713-370-0670.
List price: *$1,145.*
Circle 487 on reader service card

E-Machines

E-Machines ColorPage T16 II

BY BRUCE BROWN

The E-Machines ColorPage T16 II ($1,499 list) proved a better-than-average performer.

The ColorPage earned an above-average ranking in objective testing. Its good pincushioning results were matched in subjective testing, as were its average MTF scores.

E-Machines ColorPage T16 II

Moire patterning was heavy in 800-by-600 mode and noticeable in 1,024-by-768 mode. Switching from partial to full-screen DOS windows took about a second, but the resultant image neither flickered nor shifted.

The ColorPage ran 1,024-by-768 resolution with no problems up to a 76-Hz vertical refresh rate. Although the monitor isn't rated to work in 1,280-by-1,024 mode, we discovered that it is able to support that resolution—although only at 60 Hz and with noticeable flicker.

Glare control is adequate. The control panel includes buttons for pincushioning adjustment but none for color matching.

In sum, the ColorPage offers above-average, but not superior, performance.

▶ FACT FILE

E-Machines ColorPage T16 II
E-Machines, a division of SuperMac Technology Inc., 215 Moffett Park Dr., Sunnyvale, CA 94089; 800-344-7274; fax-back service, 800-541-4787.
List price: *$1,499.*
Circle 488 on reader service card

IBM Personal Computer Co.

IBM PS/ValuePoint 6317

BY JOHN R. QUAIN

A competent player in the 17-inch-monitor arena, the IBM PS/ValuePoint 6317 ($1,165 list) possesses no fatal flaws but is not a price/performance standout, either.

IBM PS/ValuePoint 6317

The 6317's test results in non-interlaced 1,024-by-768 resolution at 72 Hz were generally within the acceptable range. As with many of the monitors we tested, however, bringing the 6317 up to 1,280-by-1,024 resolution at 60 Hz taxed its capabilities. Small fonts were nearly illegible at this resolution, and we noticed bleeding between the black and white edges at the right side of the screen.

We easily corrected exterior pincushioning with the front panel's digital controls but we couldn't eliminate some slight bowing of interior image lines. Also, our objective tests showed that the monitor's maximum usable brightness was a low 24.6 foot-lamberts.

In general, this monitor was an adequate performer that generated neither much enthusiasm nor much disappointment.

▶ FACT FILE

IBM PS/ValuePoint 6317
IBM Personal Computer Co., Rt. 100, Somers, NY 10589; 800-426-2968; fax, 800-426-4329.
List price: *$1,165.*
Other models: *IBM Premium Color Monitor Model 9517, $1,470.*
Circle 489 on reader service card

Idek/Iiyama North America Inc.

Idek MF-8317

BY DON CRABB

The previous incarnation of the Idek MF-8317 ($1,395 list), the Idek MF-5317, suffered from cost-cutting measures that eliminated the use of microprocessors to control and remember image size and position. The MF-8317 returns the microprocessor to the control circuitry so that the monitor now boasts solid digital controls like most of the competition.

The comprehensive front panel includes digital controls for image tilt, keystoning, horizontal and vertical pincushioning and sizing, and framing relative to the screen in both horizontal and vertical modes. There's also a degaussing button and up to 33 user settings that can be stored in memory.

Unfortunately, the MF-8317 did not manage stellar performance on our tests. Its pincushion error score (0.77 mm) and maximum usable brightness score (24.4 foot-lamberts) both fell below the mean, while its MTF score (40 per-

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inches. Its footprint measures
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486 Power

You don't have to sacrifice performance to have color, either. ColorBook models are based on Intel® 486 processors. Both ColorBook models include a floppy drive, 4MB or 8MB of RAM (upgradeable to 20MB), and a large, fast hard drive. These notebooks are powerful enough to become your only computer!

Integrated Track Ball And PCMCIA Slots

The ColorBook includes a built-in track ball, which is much easier to use than a mouse in most portable situations. You also get two PCMCIA Type II card slots so you can plug in dozens of available PCMCIA peripherals.

Greener Pastures

The grass *is* greener on the ColorBook side of the fence! It's an extraordinary value even by Gateway's standards — and we wrote the book on value! We have a reputation for offering the best prices on high-quality products with exceptional service from friendly folks in the Midwest. That's why the choice of a computer supplier is black-and-white, even when you're buying a color notebook! Give us a call.

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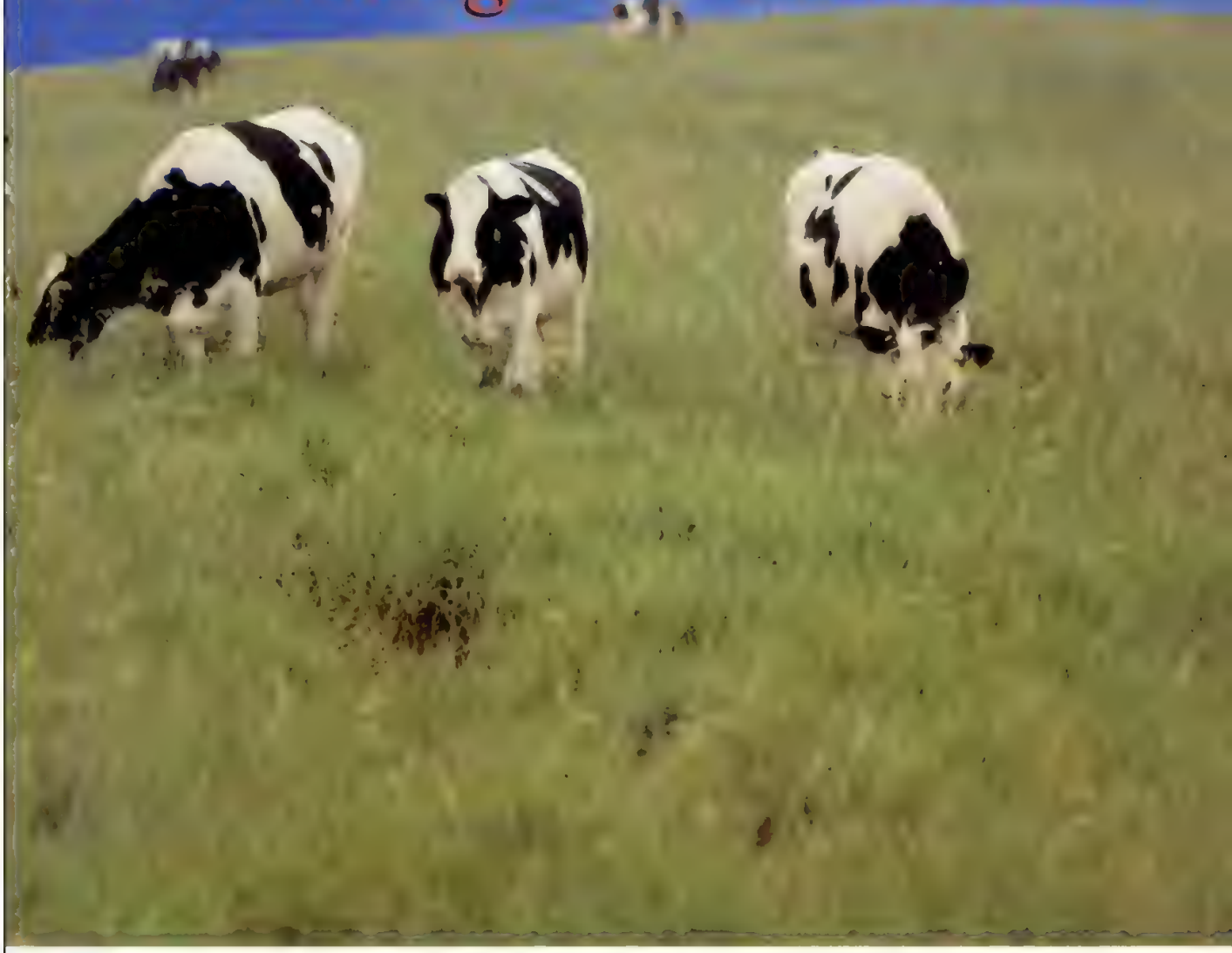
Introducing The ColorBook!



For the same money, you can have a black-and-white 486 notebook. Or you can have a color 486 notebook. Which is it going to be? Hay, it's not too hard to spot the best deal: the ColorBook from Gateway 2000! The new ColorBook has everything you're looking for in a portable at a price you'd expect to pay for a monochrome system. That's a special breed!

Exploding The Myth

Why do you expect to pay so much more for a color portable? Because other manufacturers always charge a plump premium for color. They've been milking the market, brainwashing you into thinking high-quality color costs a lot more to manufacture. It doesn't! We're selling the ColorBook for our usual cost-plus-small-margin. Now other companies will have a hard time perpetuating the color portable price myth. (Competitors absolutely *hate* us! Isn't it great?)

Experts' Reaction

We gave several PC trade publication editors a sneak preview of the ColorBook. Here's what they said about it: "Way cool!" "Dead on." "You won't be able to make enough of these."

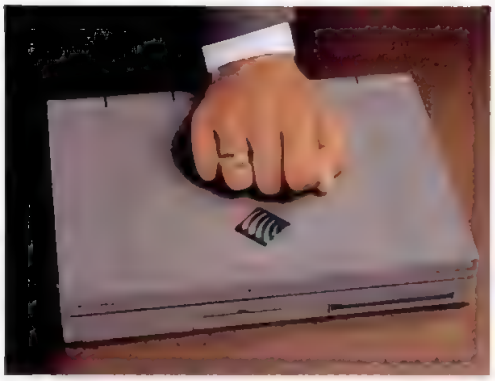
Dazzling Color Display

The editors were impressed by the bright, crisp color graphics from the latest-technology, dual-scan STN display. It's a 9.4-inch VGA LCD, backlit for use in any lighting conditions. The editors said the ColorBook has the best STN color display they had ever seen! When they learned one model was priced *less than $2,000*, they were convinced the ColorBook will cause a stampede in the industry.

No Compromise On Size

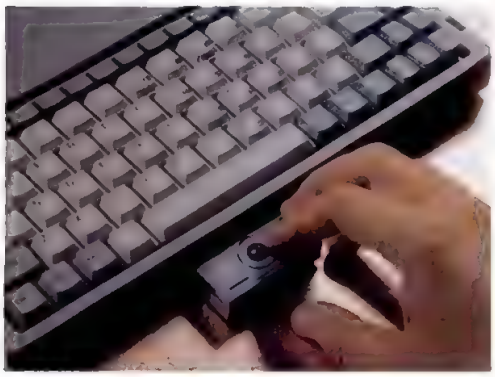
Adding color to a portable usually means adding weight and bulk. Not so with the Gateway 2000 ColorBook. The ColorBook is the thinnest color notebook on the market — 1.77

Introducing The ColorBook!



The ColorBook is the thinnest color notebook on the market — 1.77 inches. Its footprint measures only 11.7 x 8.5 inches, and it weighs just 5.4 pounds.

You'll appreciate the convenience of using PCMCIA cards. They're as easy to carry as credit cards, and they plug right into your ColorBook.



The integrated track ball slides out from a compartment by the space bar on the keyboard. You simply pull it out and go to work. Finished? Just slide the track ball back into the ColorBook.

Features

Size	With the ColorBook, you get great color at a great price while maintaining excellent portability.
Intel® 486 Processor	ColorBook notebooks are based on Intel 486 microprocessors, which makes them powerful enough to serve as your desktop PC with an external mouse, keyboard and monitor. Supports simultaneous video, up to 1024 x 768 resolution.
Dual-Scan STN Color Display	Dual-scan STN color is the latest technology in portable color displays, and it looks fabulous! You get 256 colors with the ColorBook running in VGA mode (640 x 480 resolution).
PCMCIA Type II Slots	Add a modem, network card or any of dozens of available PCMCIA-compatible peripherals. The ColorBook's two Type II slots can also be used for one Type III PCMCIA card.

ColorBook 486SX-25

- Weight: 5.4 Lbs.
- Dimensions: 11.7" x 8.5" x 1.77"
- Intel 25MHz 486SX Processor
- 4MB RAM (expandable to 20MB)
- 3.5" 1.44MB Diskette Drive
- 80MB IDE Hard Drive
- 9.4" Backlit VGA Dual-Scan STN Color Display
- NiMH Battery & AC Pack
- Suspend/Resume Feature
- 2 PCMCIA Type II Slots
- Integrated Track Ball (2 Buttons)
- 85-Key Keyboard
- Parallel, Serial & PS/2 Mouse Ports
- External CRT Port
- MS-DOS® and Windows™

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ColorBook 486SX-33

- Weight: 5.4 Lbs.
- Dimensions: 11.7" x 8.5" x 1.77"
- Intel 33MHz 486SX Processor
- 4MB RAM (expandable to 20MB)
- 3.5" 1.44MB Diskette Drive
- 170MB IDE Hard Drive
- 9.4" Backlit VGA Dual-Scan STN Color Display
- NiMH Battery & AC Pack
- Suspend/Resume Feature
- 2 PCMCIA Type II Slots
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Idek MF-8317

cent) was just above average.

The MF-8317 suffered serious misconvergence and pincushioning problems, making it less-desirable than it ought to be, given its top-flight control features.

▶ FACT FILE

Idek MF-8317

Idek/Iiyama North America Inc., 650 Louis Dr., #120, Warminster, PA 18974; 800-394-4335, 215-957-6543; fax, 215-957-6551.

List price: *$1,395.*

Other models: *Idek MF-5017, $1,195; Idek MF-5317, $1,195; Idek MF-8217, $1,245.*

Circle 490 on reader service card

KFC USA Corp.

KFC CA 1713

BY BRUCE BROWN

The shortcomings of the KFC CA 1713 ($1,195 list) put it among the bottom ranks of the monitors we looked at in this roundup.

The CA 1713 scored poorly on all of our objective tests, turning in below-average scores on our MTF and misconvergence tests and the second-worst pincushion-error score. The monitor also has no control for pincushioning, so the problem can't be corrected manually.

The CA 1713's display appeared dimmer than the displays of most of the other monitors here. The screen's antiglare protection was only moderately effective, and the monitor exhibited significant screen-size shifting when changing from full to partial DOS window screens.

KFC CA 1713

The CA 1713 exceeds its 70-Hz rating in 1,024-by-768 mode, running well at 72 Hz. It also runs successfully at its highest-rated 60-Hz vertical refresh rate in 1,280-by-1,024 resolution.

From its badly written user manual to its dim screen and poor image control, the KFC CA 1713 is disappointing.

▶ FACT FILE

KFC CA 1713

KFC USA Corp., 1585 Sunland Ln., Costa Mesa, CA 92626; 800-253-2872, 714-546-0336; fax, 714-546-0315.

List price: *$1,195.*

Other models: *KFC CA 1712, $1,045.*

Circle 491 on reader service card

Liberty Electronics

Liberty CL-9117

BY JOHN R. QUAIN

The Liberty CL-9117 ($1,049 list) proved only a satisfactory performer. Based on a Toshiba flat-square tube, the CL-9117 achieved respectable misconvergence

Liberty CL-9117

scores and one of the best MTF scores. But its overall image score suffered from merely adequate brightness and some pincushioning problems.

Maximum usable brightness was tolerable at 26.1 foot-lamberts, but maximum brightness was considerably higher at 44.8 fL. Thus, boosting the brightness control on this monitor caused discernible color bleeding and a loss of focus.

Most off-putting, however, are the CL-9117's image controls. Located on the right side of the monitor, they are extremely awkward to operate. Image parameters are selected by turning a tiny dial, while a single pair of up/down buttons are used for adjustments. This arrangement requires you to crane your neck to see the dial position and make adjustments. The CL-9117 could also use a manual degaussing button.

The Liberty CL-9117 has image controls which are extremely awkward to operate.

Although the CL-9117 is rated to 1,280-by-1,024 noninterlaced mode at a 70-Hz vertical refresh rate, it is not comfortable doing so.

Average performance and an annoying control panel make the CL-9117 a merely adequate monitor.

▶ FACT FILE

Liberty CL-9117

Liberty Electronics, 48089 Fremont Blvd., Fremont, CA 94538; 510-623-6000; fax, 510-623-7021.

List price: *$1,049.*

Circle 492 on reader service card

MAG InnoVision Inc.

MAG MX17F

BY JOHN R. QUAIN

The MAG MX17F, an Editors' Choice winner last year, earns an honorable mention this year. Though competitively priced ($1,499 list), the MX17F has an active screen that is smaller (15.5 inches diagonal) than many of its rivals' screens,

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March 16, 1993
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Active Display Size (mm) *	267x200	267x200	267x200	267x200	280x210	316x237
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Vertical Scanning (Hz)	50-100	50-100	50-100	50-100	50-100	50-100
VESA 640x480@72Hz	•	•	•	•	•	•
VESA 800x600@56/60Hz	•	•	•	•	•	•
VESA 800x600@72Hz		•	•	•	•	•
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CIRCLE 226 ON READER SERVICE CARD

and it lacks color-adjustment controls. Controls are located up front, and an LCD panel displays messages that are helpful when programming the monitor.

The MX17F earned the best pincushioning-error scores, and its color

MAG MX17F

fidelity was admirable. Image sharpness, however, was merely above average. We saw tiny convergence errors in the extreme corners at 1,024-by-768 resolution, which were verified by the monitor's below-average misconvergence scores. Maximum usable brightness also was less than ideal. In 1,280-by-1,024 at 60 Hz, the MX17F's image remained sharp, but we noticed misconvergence in the screen corners.

Overall, however, these were minor flaws in an otherwise well-balanced monitor. Though it was a notch below the top performers in this year's roundup, the MX17F can still be considered a superior monitor.

▶ FACT FILE

MAG MX17F

MAG InnoVision Inc., 2801 S. Yale St., Santa Ana, CA 92704; 800-827-3998, 714-751-2008; fax, 714-751-5522.

List price: *$1,499.*

Circle 493 on reader service card

Nanao USA Corp.

Nanao Flexscan F550i
Nanao Flexscan F550i-W

BY DON CRABB

The display of the Nanao Flexscan F550i ($1,499 list) does not appear as bright as some of the other displays in our roundup, but this is a conscious design decision that enables Nanao to keep its products' images tightly focused. Consequently, the F550i's transient response is excellent, exhibiting none of the blooming and color bleeding witnessed on some of the brighter monitors.

An unusual, and useful, feature of the F550i is its multifunction front-control panel. A row of membrane buttons allows you to adjust for pincushioning, brightness, contrast, and vertical and horizontal size and position. Once you make a selection, adjustments are made using a single digital dial control.

The F550i's screen produces razor-sharp images with deep colors; it also has a good antiglare coating. The F550i placed eighth on our MTF tests and a somewhat disappointing twelfth on our misconvergence tests. More disappointing was a nineteenth-place finish on our pincushioning-error tests. We found, however, that most of the error could be corrected with the excellent controls. Despite these scores, the F550i was perceived as being sharper and better focused than most of the other monitors tested, largely due to its lack of blooming.

While comparatively expensive, the F550i showed itself as one of the most capable and feature-rich monitors here. Though it's no longer the ultimate 17-inch display (an honor that the new Flexscan F550i-W can rightly claim), it's still a big winner.

NANAO FLEXSCAN F550I-W

Like its older cousin, the Flexscan F550i, the Nanao Flexscan F550i-W ($1,599 list) offers one of the clearest and most stable displays of any 17-inch color monitor here. Its key difference is the two-step power-saver circuit that really does save power when the monitor is idle.

You'll find a tight 0.28-mm dot pitch Invar shadow-mask tube mated to electronics that multiscan from 27 kHz to 65 kHz in the horizontal dimension and 55 Hz to 90 Hz in the vertical. These electronics provide a stable image that's uniformly bright across the flat screen, yet sharply in focus. Unlike some of the other monitors we tested, the F550i-W suffered none of the pixel blooming or poor transient response that occurs when a monitor's tube is being overdriven to saturate colors.

As good as the image was on the F550i, the image on the F550i-W was even better. The slight screen bounce we noticed on the F550i at 1,024-by-768—when switching between full-screen DOS and Windows—was absent here. In addition, the blue convergence error we found with the F550i was largely absent with the F550i-W. Virtually any minor image defects our SuperSpot testing did discover, the F550i-W's microprocessor-based front-panel controls were good enough to correct.

If you have $1,100 (street price) to spend, this Editors' Choice monitor—with its rock-solid image and pure, deep colors—will not disappoint.

▶ FACT FILE

Nanao Flexscan F550i

EDITORS' CHOICE ▶ Nanao Flexscan F550i-W

Nanao USA Corp., 23535 Telo Ave., Torrance, CA 90505; 800-800-5202, 310-325-5202; fax, 310-530-1679.

List price: *Nanao Flexscan F550i, $1,499; Nanao Flexscan F550i-W, $1,599.*

Circle 494 on reader service card

Nanao Flexscan F550i, Nanao Flexscan F550i-W

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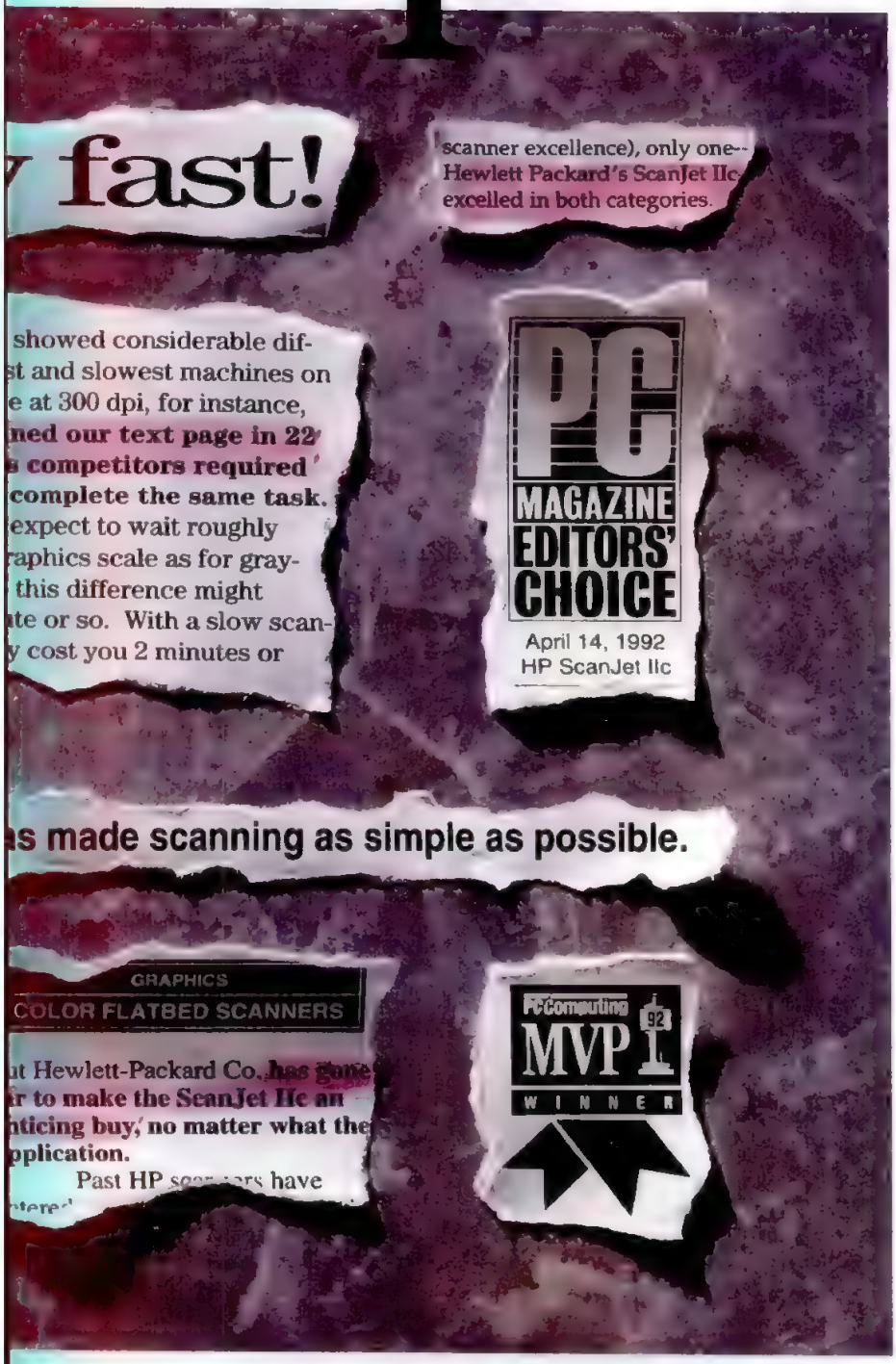

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HEWLETT PACKARD

What the Numbers Mean

Our Spotmeter tests—a monitor's harshest critic—yielded a spectrum of performance characteristics. The best-scoring monitors, of which the Sony was the top, displayed a well-balanced blend of brightness and sharpness, with little measurable distortion.

At the low end of the spectrum were the Samsung, KFC, and Samtron monitors. The Sony CPD-1730 was clearly the best performer. It ranked first in maximum usable brightness, tied for the lowest misconvergence, and maintained better-than-acceptable scores on our MTF and Pincushioning tests. In short, the Sony has an extremely bright, sharply focused screen. Both of the offerings from Nanao (the Nanao Flexscan F550i and F550i-W) fared well, as did the ViewSonic 17. Not far behind were the Addonics C172A/LR, the NBC MultiSync 5FG, and the Panasonic PanaSync/Pro C1795E.

At the opposite end of the spectrum, the two Samsung monitors (the Samsung SyncMaster 4 Plus and 5c) were generally the worst units on our MTF, misconvergence, and pincushioning tests. Unlike the SyncMaster 5c, the KFC CA 1713 excelled in terms of vertical pincushioning, but its severe horizontal pincushioning offset the advantage completely. While the Samtron SC-726V had an average misconvergence score, it was below average on MTF and did very poorly on our brightness and pincushioning tests.

The combination of high MTF and Maximum Usable Brightness scores represents an important result. Monitors that score well on both of these tests retain their focus at high brightness levels. While the Amax Impression7 and ZDS ZCM-1790 tied for the top score on our test of sharpness (an Average MTF score of 52 percent), they have comparatively low brightness at the same optimized settings (Maximum Usable Brightness readings of 20.1 and 15.1 fL, respectively), indicating that the user will have to choose between a sharp, relatively dim display and a brighter, less focused screen.

By contrast, the Nanao Flexscan F550i-W, which scored 50 percent on the MTF test, achieved a Maximum Usable Brightness score of 29.9 fL. Thus, at the same sharply focused setting, the Nanao monitor is noticeably brighter, and the intrinsic trade-off between brightness and focus is less troubling.

All of the monitors praised above did well on this crucial combination of tests, as did the AcerView 76i, the Liberty CL-9117, the NEC MultiSync 5FGe, and the Swan 17LR.

How We Tested

For this roundup of monitors, ZD Labs used a Northgate Slimline SP 433 with an ATI Graphics Ultra Pro video adapter. We set the resolution to 1,024-by-768 and used a 70-Hz refresh rate. We used three pieces of equipment for data collection: a Microvision Superspot 100 for testing modulation transfer function, misconvergence, and pincushioning; a Newport Optical table to isolate the Superspot and each monitor from external vibrations; and a Minolta Color Analyzer CA-100 to measure the maximum usable brightness of each monitor.

The **Average MTF** (Modulation Transfer Function) can be loosely defined as the ratio of contrast to maximum usable brightness; it serves as an indicator of a monitor's sharpness. A sharp monitor will have a high level of black/white contrast even when displaying closely spaced lines.

To test this quality, we have each monitor display a pattern consisting of alternating 1-pixel-wide black and white vertical lines. Inferior monitors tend to blur this pattern, producing an image with a gray appearance overall. We adjust the contrast and brightness levels to achieve the largest possible MTF and record the result. We then display a pattern of horizontal lines, and we report the average of the two results. A higher score reflects a better ability to represent fine detail, most noticeable in the crisp display of text.

As the brightness is increased, the increased intensity of the electron beams that scan across the screen's phosphors results in decreased focus. **Maximum Usable Brightness** is measured after the best possible focus has been achieved for the MTF measurements. A white raster image is displayed, and the Color Analyzer measures the resulting luminance.

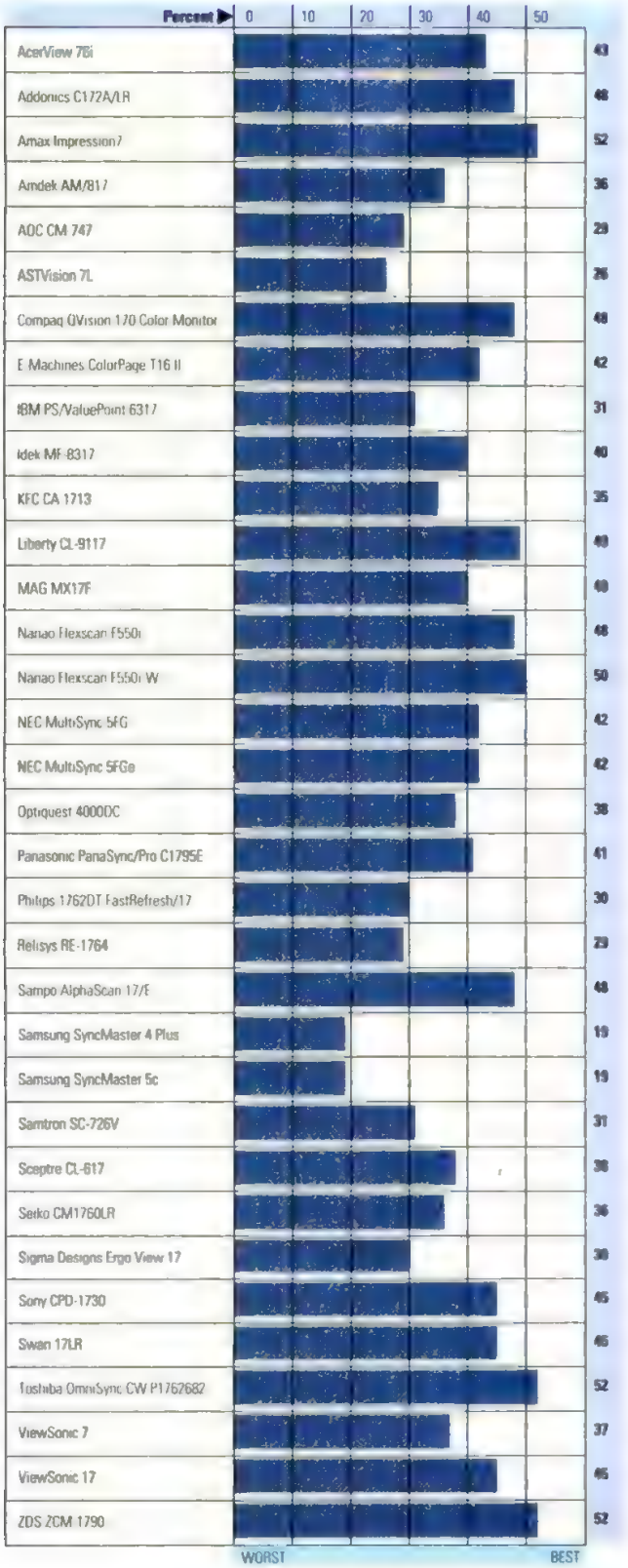
A monitor displays color by means of an internal phosphor coating consisting of fine dots (for a shadow mask) or thin lines (for a Trinitron unit) made up of three types of phosphors, which produce red, green, and blue light when excited by electron beams. Monitors typically use a separate beam for each phosphor type. When the beams are misaligned, colored halos appear around on-screen objects. This phenomenon is called ***misconvergence,*** and it is usually most apparent at the corners of the screen, where the electron beams have been most subject to deflection from their origin behind the center of the screen.

In our **RMS Misconvergence** test, we display five white horizontal lines across the screen, followed by five white vertical lines. We measure the beam displacement between red, green, and blue dots within a given line near each corner and at the center of the display. We report the ***root mean square*** of the results, or RMS misconvergence.

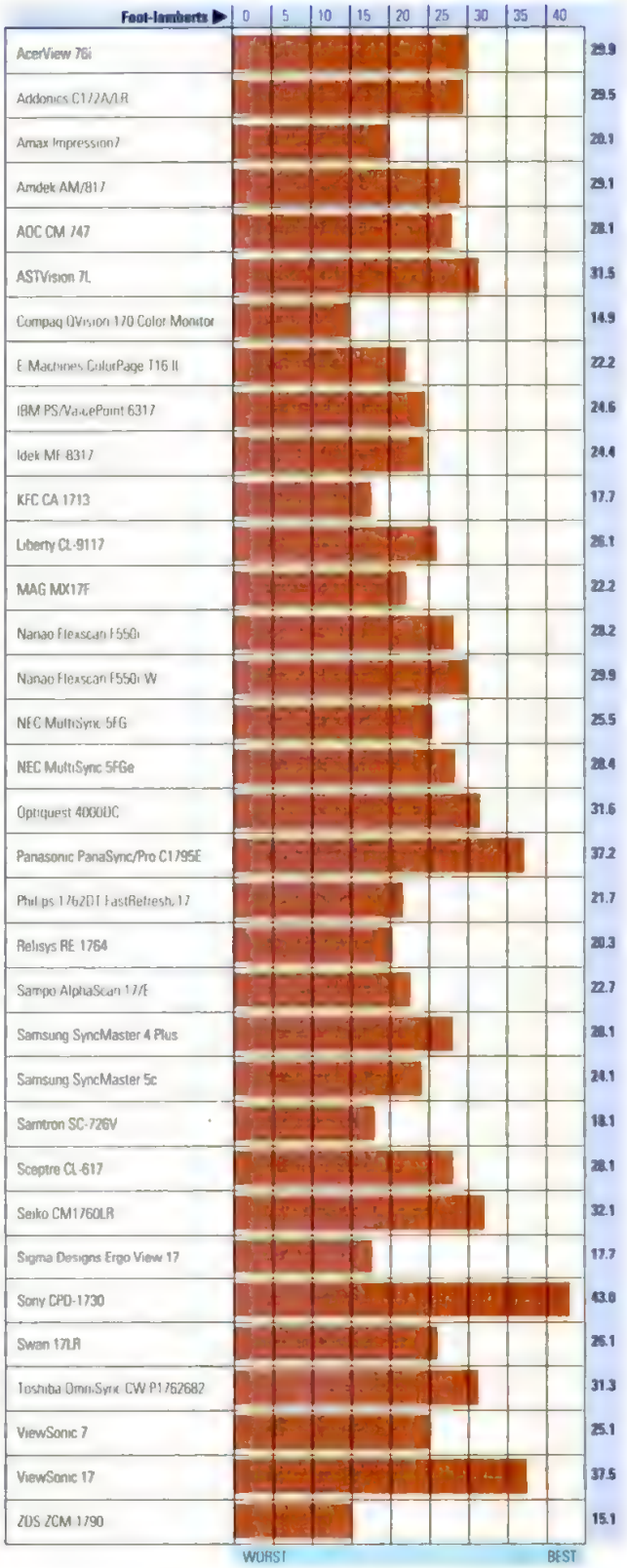
Pincushioning is a measure of the amount of curving or bowing of an ostensibly straight line. Lines positioned at the edges of the screen tend to exhibit much greater curvature than lines at the center because of the increased deflection of the electron beam. We report separate scores indicating the average vertical pincushioning and average horizontal pincushioning for each monitor.

Note that most of the monitors in this review enable adjustment of vertical pincushioning. This affects the results in two ways. First, each monitor's horizontal puncushioning is almost always more severe than its vertical pincushioning. Second, because the vertical pincushion controls were adjusted by eye, they are constrained by the limits of the tester's ability to determine a straight line—approximately ±0.7 mm. The Spotmeter is able to measure much more precisely—roughly ±0.1 mm. Thus, it is important to realize that monitors exhibiting vertical pincushioning of less than 0.7 mm have acceptable performance.

AVERAGE MTF

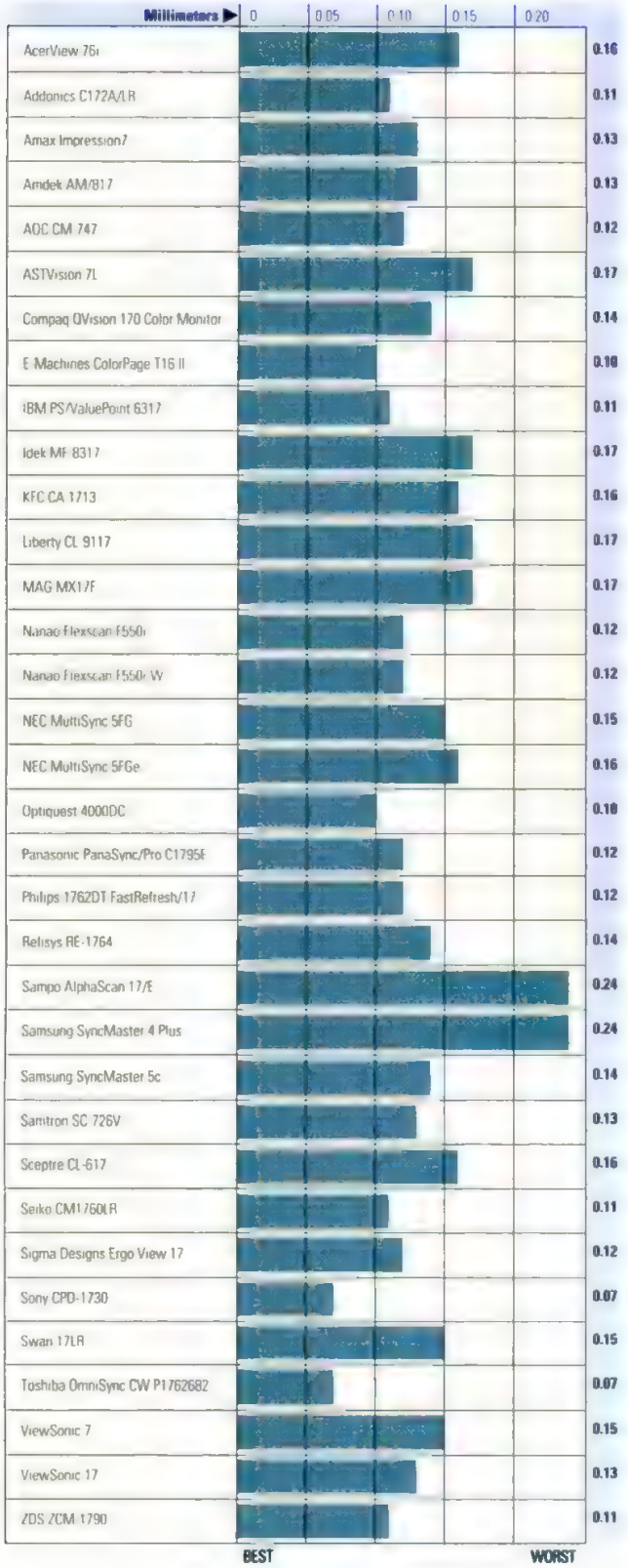


MAXIMUM USABLE BRIGHTNESS

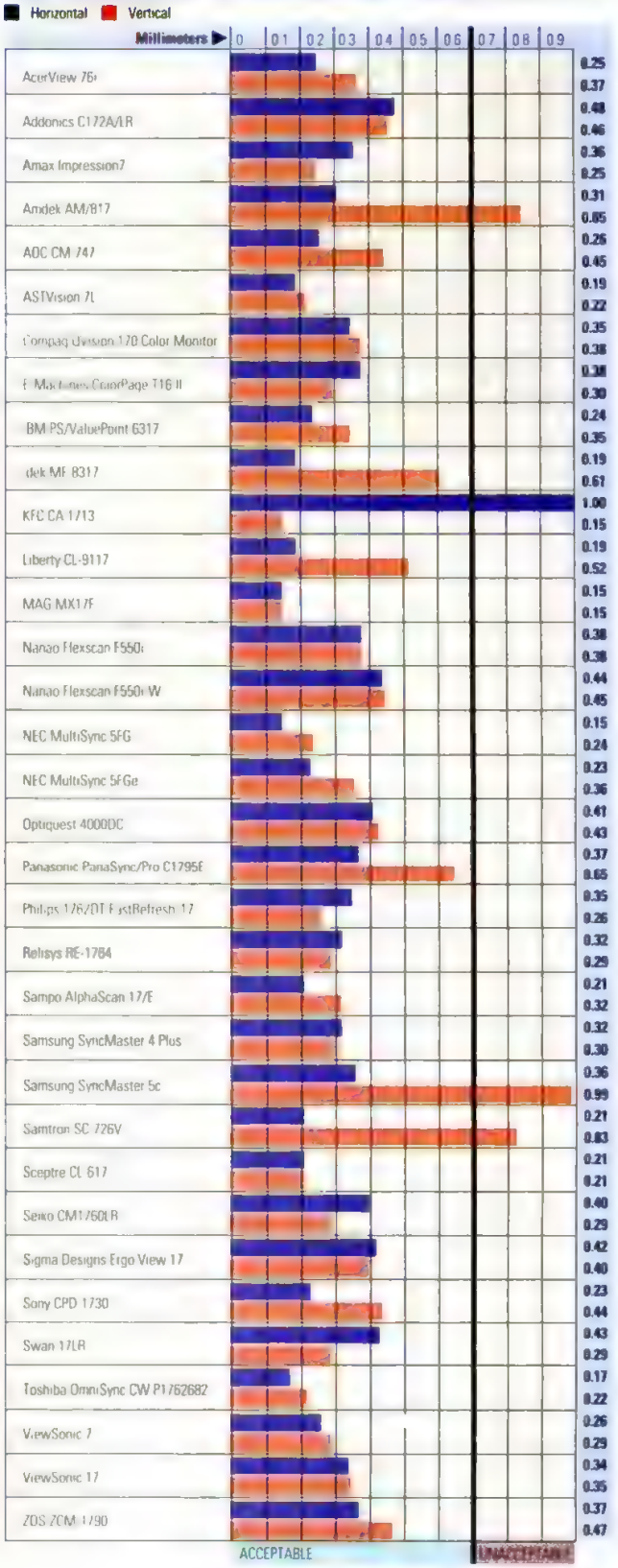


Performance Tests: 17-Inch Monitors

RMS MISCONVERGENCE



PINCUSHIONING



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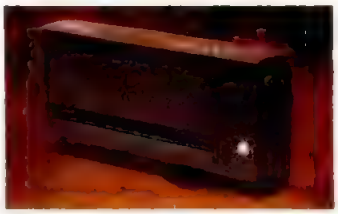

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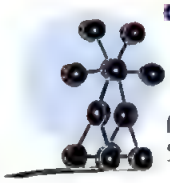

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PCM0931

NEC Technologies Inc.

NEC MultiSync 5FG
NEC MultiSync 5FGe

BY BRUCE BROWN

An Editors' Choice recipient, the NEC MultiSync 5FG ($1,355 list) was one of the most impressive performers in this year's roundup.

The 5FG worked well in 1,024-by-768 resolution at a 76-Hz vertical refresh rate and in its highest-rated mode of 1,280-by-1,024 resolution at a 74-Hz vertical refresh rate.

Although it was not one of the very top scorers during objective testing, the 5FG managed an overall performance that was above average. It posted an average misconvergence score, an above-average MTF score (indicating fine differentiation between black and white), and one of the best pincushioning scores we saw. The monitor's front panel includes pincushioning and color-matching controls.

Typical of NEC displays, the 5FG has abundant glare, and users are advised to buy one of the company's optional anti-glare screens (called MultiSync Monitor Lenses). These screens come in dark and light tint and sell for $99. NEC recommends the light screen for general-purpose use.

Still a standard by which other monitors are measured, the 5FG is among the finer displays available. It also is among the higher-priced models, however, with a $1,300 street price.

MULTISYNC 5FGe

At $1,155 (list), the NEC MultiSync 5FGe is priced lower than its sibling. Another difference between the models is that the 5FG supports a higher resolution.

The 5FGe and 5FG use the same 0.28-mm dot pitch NEC tube with a 15.56-inch diagonal active screen. The 5FGe can run in 1,024-by-768 resolution at a flicker-free 76-Hz noninterlaced mode. It's not rated to support 1,280-by-1,024 resolution, but it will run it at an 87-Hz vertical refresh rate in an interlaced mode.

NEC MultiSync 5FG, NEC MultiSync 5FGe

The 5FGe did not score as well as its sibling on our misconvergence tests, posting scores that were somewhat worse than average. Its MTF and pincushioning scores were above average, however, which secured its above-average overall score.

Vertical-line moire patterns were observable but not extreme in both 800-by-600 and 1,024-by-768 modes. When shifting from full to partial DOS windows, the 5FGe performed beautifully, with no flicker, bounce, or jump. As with the 5FG, the 5FGe's high-glare tube cries out for the optional add-on glare screen.

The 5FGe performs well and is a good choice for users who can live without the 5FG's higher performance.

▶ FACT FILE

EDITORS' CHOICE ▶ NEC MultiSync 5FG
NEC MultiSync 5FGe
NEC Corp., 1255 Michael Dr., Wood Dale, IL 60191; 800-388-8888; fax-back service, 800-366-0476.
List price: *NEC MultiSync 5FG, $1,355; NEC MultiSync 5FGe, $1,155.*
Circle 495 on reader service card

Optiquest Inc.

Optiquest 4000DC

BY JOHN R. QUAIN

The Optiquest 4000DC ($999 list) is an inexpensive monitor that boasts some sophisticated niceties and delivers good performance in 1,024-by-768 resolution.

Not only was the 4000DC's maximum usable brightness one of the four best we measured, it also matched the monitor's maximum brightness, which means you can drive the monitor at full brightness without fear of color distortion or loss of focus.

The 4000DC's average MTF scores were a little below the median of the test group, but perceived sharpness was not a problem during subjective testing. Although we saw no pincushioning or barrel effect, the 4000DC's picture did become unstable when raised to its maximum resolution of 1,280-by-1,024 at 60 Hz.

The 4000DC's controls were the best in this roundup. Rather than relying on buttons and dials, you can consult on-screen menus to adjust the picture.

There are several features that argue in favor of the 4000DC. Even though it's not rated MPR II–compliant, it passed VLF and ELF emissions tests, and its controls are a bonus.

▶ FACT FILE

Optiquest 4000DC
Optiquest Inc., 20490 E. Business Pkwy., Walnut, CA 91789; 800-843-6784, 909-468-3750; fax, 909-468-3770.
List price: *$999.*
Other models: *Optiquest 4000D, $999.*
Circle 496 on reader service card

Optiquest 4000DC

Panasonic Communications & Systems Co.

Panasonic PanaSync/Pro C1795E

BY JOHN R. QUAIN

With a $1,579 list price that places it among the most expensive monitors in this roundup, the Panasonic PanaSync/Pro C1795E justifies the expense by offering all the control and flexibility a PC user could want in a 17-inch monitor. It gives you a 15.6-inch diagonal screen area with one of the sharpest images (even when it's in 1,280-by-1,024 mode) for your money.

Panasonic PanaSync/Pro C1795E

In 1,024-by-768 mode, the PanaSync/Pro proved a sure-footed performer. When toggling between DOS and Windows, we found all on-screen objects stayed right where they should.

Its performance in its maximum noninterlaced resolution of 1,280 by 1,024 revealed the PanaSync/Pro's real strengths. Unlike most of the 17-inch contenders here, which can achieve a vertical refresh rate of only 70 Hz or less in this mode, the PanaSync/Pro's image remained rock solid at 74 Hz.

For users looking for everything in one monitor, the PanaSync/Pro is a leading performer with one of the best 1,280-by-1,024 displays we saw, as well as a full set of state-of-the-art controls.

▶FACT FILE

Panasonic PanaSync/Pro C1795E
Panasonic Communications & Systems Co., 2 Panasonic Way, Secaucus, NJ 07094; 800-742-8086, 201-348-7000.
List price: *$1,579.*
Circle 497 on reader service card

Philips Consumer Electronics Co.

Philips 1762DT FastRefresh/17

BY DON CRABB

Finding any Philips monitor can be tough, since the company functions primarily as an OEM. And, unfortunately, our tests showed that even if you can find a Philips 1762DT FastRefresh/17 ($1,299 list), you might end up regretting the search.

Philips 1762DT FastRefresh/17

The problem is not with its control setup, which features analog brightness and contrast controls, as well as digital controls for horizontal and vertical positioning and size, pincushioning, convergence, and keystoning. The problem rests solely in the distinctly mediocre picture that this combination of goodies produces.

The 1762DT fared poorly on our tests. It ranked twenty-fourth in maximum usable brightness and seemed muted in subjective testing.

With its top digital-control setup and quality components, the 1762DT should have offered a better image; its image defects make it a disappointment.

▶FACT FILE

Philips 1762DT FastRefresh/17
Philips Consumer Electronics Co., One Philips Dr., P.O. Box 14810, Knoxville, TN 37914-1810; 800-835-3506, 615-521-4316; fax, 615-521-3210.
List price: *$1,299.*
Other models: *Philips 1764DC FastRefresh/17, $1,249; Philips Brilliance 1720, $1,499; Magnavox MagnaScan/17 CM9217, $1,199.*
Circle 498 on reader service card

Relisys RE-1764

Relisys

Relisys RE-1764

BY JOHN R. QUAIN

Relying on basic analog controls and delivering below-average picture performance, the Relisys RE-1764 ($1,395 list) lagged significantly behind the majority of the 17-inch monitors here in nearly every respect. Although its street price is low ($799), so is its picture quality.

We noticed a distinct lack of sharpness and detail when the monitor displayed screens of text in Windows. Further contributing to our poor impression was a subpar maximum-usable-brightness measurement of 20.3 foot-lamberts. At its maximum noninterlaced resolution of 1,280 by 1,024 at 60 Hz, the monitor suffered a noticeable deterioration of focus, with smaller fonts lacking clarity and crispness.

The RE-1764's analog front-panel controls represent a no-frills approach; there are no pincushioning, barreling, or color controls. Because the unit lacks a microprocessor, transitions between video modes sometimes call for slight screen-size and position adjustments.

Although none of the RE-1764's flaws are glaring problems individually, collectively they add up to a mediocre product.

▶FACT FILE

Relisys RE-1764
Relisys, 320 South Milpitas Blvd., Milpitas, CA 95035; 800-783-2333, 408-945-9000; fax, 408-945-0587.
List price: *$1,395.*
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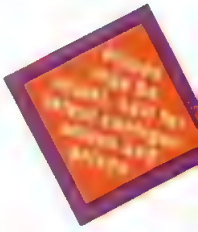

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Sampo Corp. of America

Sampo AlphaScan 17/E

BY BRUCE BROWN

The Sampo AlphaScan 17/E ($1,495 list) did not measure up to the better monitors in this roundup primarily because of its poor convergence control.

One of the 17/E's best traits is its ability to run high-resolution modes at fast refresh rates. It ran very well in 1,024-by-768 mode at 76 Hz and in 1,280-by-1,024 mode at 74 Hz.

Posting top scores on our MTF tests and above-average pincushioning scores, the 17/E suffered from one of the two worst misconvergence test scores in this roundup. This spoiled an otherwise fine showing.

When shifting from partial to full-screen DOS windows in both 800-by-600 and 1,024-by-768 resolutions, the 17/E paused, rephased, and visibly resized the image.

The 17/E's high performance points (ability to handle fast high-resolution modes) are offset by its faults (poor convergence, moire patterning, and inadequate mode-shifting power), which made it a decidedly mediocre performer overall.

▶ FACT FILE

Sampo AlphaScan 17/E

Sampo Corp. of America, 5550 Peachtree Industrial Blvd., Norcross, GA 30071; 404-449-6220; fax, 404-447-1109.

List price: *$1,495.*

Other models: *Sampo AlphaScan 17, $1,150.*

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Sampo AlphaScan 17/E

Samsung SyncMaster 4 Plus, Samsung SyncMaster 5c

Samsung Electronics America Inc.

Samsung SyncMaster 4 Plus
Samsung SyncMaster 5c

BY BRUCE BROWN

Though it did not score as poorly as its sibling—the Samsung SyncMaster 5c—the Samsung SyncMaster 4 Plus ($1,299 list) still fell among the lowest-scoring and poorest-performing monitors in this roundup.

The 4 Plus uses a 0.31mm dot pitch Toshiba tube with a 16-inch diagonal viewing area. The monitor tied for last place on our MTF and misconvergence tests. It was helped only by a somewhat higher-than-average pincushioning score and good glare control.

Its poor MTF performance was matched in subjective testing, when alternating black and white lines appeared to be varying shades of gray. Although moire patterning was unnoticeable in 800-by-600 mode, it was extreme in 1,024-by-768 mode. The monitor showed visible convergence errors in both modes.

The 4 Plus ran well in 1,024-by-768 resolution at 76 Hz. But in 1,280-by-1,024 resolution at a slow 60-Hz vertical refresh rate, we saw noticeable flicker (the 4 Plus won't run faster at this resolution).

In sum, the 4 Plus proved one of the least satisfactory performers here.

SAMSUNG SYNCMASTER 5c

Though the Samsung SyncMaster 5c ($1,399 list) is more expensive and is supposed to be a better monitor than the SyncMaster 4 Plus, it did not perform as well as its sibling in objective and subjective testing.

Offering an NEC tube with a 0.26mm dot pitch and a 15.88-inch diagonal active screen area, the 5c appears to be equipped for good performance. It turned in the worst pincushioning score here, however. Although the 5c's misconvergence score was average, its MTF score tied for last place with the 4 Plus's score.

The 5c's screen was very dim, and images were fuzzy compared with those of the other monitors we reviewed. Moreover, we found that shifting between full and partial DOS windows took 2 full seconds.

The 5c ran well in 1,024-by-768 mode at 76 Hz; it can function in 1,280-by-1,024 mode at 70 Hz but with an uncorrectable pincushioning error.

The 5c's glare control is acceptable. And while the monitor isn't MPR II-compliant, it did pass the ELF and VLF emissions standards.

The 5c unit we tested was the worst-performing monitor in this review. Samsung needs to reengineer or better manufacture the monitor in order to make it competitive with the better monitors available.

▶ FACT FILE

Samsung SyncMaster 4 Plus
Samsung SyncMaster 5c

Samsung Electronics America Inc., 105 Challenger Rd., Richfield Park, NJ 07660-0511; 800-726-7864, 201-229-4000, ext. 4065; fax, 201-229-4110.

List price: *Samsung SyncMaster 4 Plus, $1,299; Samsung SyncMaster 5c, $1,399.*

Circle 501 on reader service card

Samtron Displays Inc.

Samtron SC-726V

BY DON CRABB

While the Samtron SC-726V ($1,199 list) suffered from disappointing image distortions, it caused us few problems when displaying Windows icons, text, and graphics.

This bare-bones unit lacks the fancy digital controls of monitors like the Nanao units. It offers instead basic analog thumb-wheel controls for brightness, contrast, and horizontal and vertical position and size. Their precision proved average during testing, but they were nonetheless effective.

Samtron SC-726V

Color separation was good, and there was no serious blooming noticed during subjective testing. The SC-726V synced adequately in high-resolution modes, but we had to tweak the controls a bit to fix some bowing.

The SC-726V is a good buy for users on a limited budget. Clarity and color quality are good, and the display is fairly easy on the eye. The SC-726V did display considerable geometric distortion, although its 0.26-mm dot pitch helped conceal the defects.

▶ FACT FILE

Samtron SC-726V

Samtron Displays Inc., 14251 E. Firestone Blvd., #101, La Mirada, CA 92649; 310-802-8425; fax, 310-802-8820.

List price: *$1,199.*

Other models: *Samtron SC-726VL, $1,229.*

Circle 502 on reader service card

Sceptre Technologies Inc.

Sceptre CL-617

BY BRUCE BROWN

The Sceptre CL-617 ($1,395 list) was an above-average performer by most objective and subjective measures, but its performance figures weren't impressive enough to put it in the top ranks. Moreover, the CL-617 is hindered by a less-than-perfect feature set.

Sceptre CL-617

Based on a 0.26-mm dot pitch Hitachi tube with a 15.94-inch diagonal active screen area, the CL-617 will run at 72 Hz in 1,024-by-768 resolution. In 1,280-by-1,024 mode, it runs at only 60 Hz, and with some flicker.

The CL-617 earned an above-average overall objective test score. It posted a slightly below-average misconvergence score (not enough to be visible during subjective testing, though), an average MTF score, and one of the best pincushioning error scores.

The CL-617's glare control was good. In a departure from the norm, the monitor's user controls are located on the base, and a pincushion control is included.

In sum, the CL-617 turned in a slightly above-average performance in a field that includes some exceptional monitors.

▶ FACT FILE

Sceptre CL-617

Sceptre Technologies Inc., 560 S. Melrose St., Placentia, CA 92670; 800-788-2878, 714-579-4153; fax, 714-993-2997.

List price: *$1,395.*

Other models: *Sceptre CL-617L, $1,495.*

Circle 503 on reader service card

Seiko Instruments USA Inc.

Seiko CM1760LR

BY JOHN R. QUAIN

For a monitor based on the respected Sony Trinitron tube, the Seiko CM1760LR ($1,449 list) was a disappointment. Unexceptional performance and less-than-state-of-the-art controls placed it among the second-tier players in this roundup.

Getting a bright picture from the CM1760LR was difficult. Even though maximum brightness was a respectable 32.3 foot-lamberts, noticeable color bleeding and fuzziness occurred when the monitor was driven to that level. This kept the maximum usable brightness to a rather dull 17.7 fL.

Pincushioning-error results were a bit below average, and the monitor's faults were more pronounced in 1,280-by-1,024 noninterlaced mode at 60 Hz.

Analog thumb-wheel controls include only the basics: There are no pincushioning, barrel-distortion, or color-correction controls. Also, the absence of a microprocessor means that mode switches require some resizing of the image.

Not the worst and not the best of the 17-inch-monitor crowd, the CM1760LR failed to match the performance of the other Trinitron-based contenders.

▶ FACT FILE

Seiko CM1760LR

Seiko Instruments USA Inc., 1130 Ringwood Court Ave., San Jose, CA 95131; 800-888-0817, 408-922-5800; fax, 408-922-5835. List price: *$1,449.*

Circle 504 on reader service card

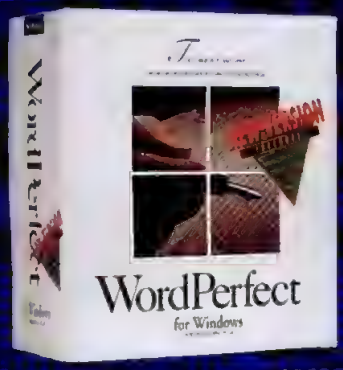
Seiko CM1760LR

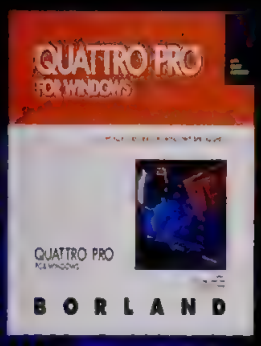
THE PERFECT PC

PC MAGAZINE EDITORS' CHOICE

January 26, 1993
466 Magnum

THE PERFECT SOFTWARE





MICRON MEANS... QUALITY

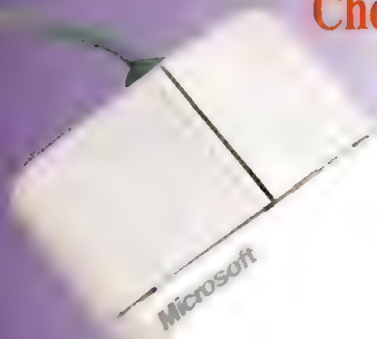
January 26, 1993
466 Magnum

Bundled With Every System

- Microsoft® Mouse 2.0
- Microsoft Windows™ 3.1
- Microsoft DOS 6
- Your choice of:
  - *WordPerfect for Windows*
  - *WordPerfect Presentations*
  - *Quattro Pro for Windows*
  - *Paradox for Windows*

Choose One At No Charge . . . Or Get All 4 For $199*

*With System Purchase



WordPerfect for Windows

Now with Grammatik 5, as well as Adobe Type Manager and 12 new fonts. It also includes the new QuickFinder file indexer, QuickMenu support for OLE, and is mail-enabled.

WordPerfect Presentations

WordPerfect Presentations is presentation graphics, designed for those who want to put together powerful, persuasive, and elegant presentations with a minimum of fuss.

Paradox for Windows

The new relational database from Borland that delivers ease of use, power and the tools you need to create graphical applications fast.

Quattro Pro for Windows

The revolutionary spreadsheet created expressly for Windows. Hot new features like spreadsheet Notebooks, and Object Inspector menus make it the most advanced spreadsheet technology ever created for Windows.

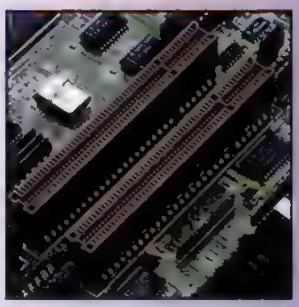
MICROSOFT WINDOWS READY-TO-RUN

MICRON MEANS... PERFORMANCE

Pentium™ OverDrive™ Ready

At the heart of every Micron 486VL system is a Zero Insertion Force (ZIF) socket designed for processor upgrades from the 33MHz 486SX to the 66MHz 486DX2 all the way to Intel's future Pentium based Overdrive processors. Just lift the lever and change the processor.

VESA Local Bus • Block Mode IDE



With 2 VESA local bus slots and an integrated 32-bit local bus IDE interface, you can have up to 3 local bus devices including bus mastering cards. The integrated local bus IDE interface features Block Mode Transfer (BMT) providing a 20 - 30% performance increase.

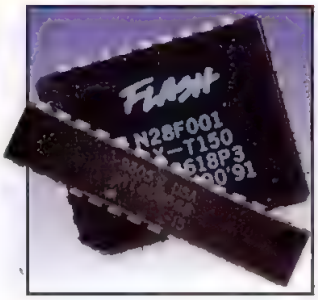
Micron Means More Memory

With 16MB of RAM standard on most systems, you'll be equipped for the most demanding software. Since Micron is one of the world's largest memory manufacturers, 32MB and 64MB memory upgrades are available at rock bottom prices.
Call and compare!

Diamond Viper VLB Accelerator

Powered by the Weitek™ P9000 the Viper VLB is up to 300% faster than the ATI Ultra Pro VLB. 2MB of VRAM provides 256 colors at 1280 x 1024 @ 74Hz and 16.7 million colors at 800 x 600. Turbo Windows and Panacea AutoCAD drivers included.

256K 15ns Cache • Flash BIOS



With 256K of ultra-fast Micron 15ns SRAM cache, your systems memory architecture will be fully exploited. A large fast cache is essential for OverDrive processors. Upgradeable Flash BIOS allows you to update your firmware from a floppy drive or modem.

Award Winning Monitors by MAG

Award Winning MAG InnoVision monitors have received four PC Magazine Editors' Choice awards in consecutive years, providing unsurpassed clarity and features. Why settle for an average monitor when you can have the very best.

Rock Solid Quality Drives

Maxtor hard drives provide rock solid reliability with an average Mean-Time-Between-Failure (MTBF) of over 300,000 hours. Think of it as data insurance. Teac dual media floppy drives provide both 3.5" and 5.25" drives in a single drive bay freeing space for CD-ROM and tape drives.

Superior Systems by Design

Upgrades are a snap with the "Tool Free" single thumbscrew design of the desktop chassis. A low profile heat sink comes standard on 66MHz systems for added cooling. 2.88MB floppy drive support assures you'll be ready when standards change.

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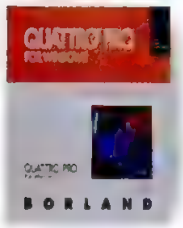
MICRON MEANS... VALUE

Pick One:



Or Get All 4 For $199
*With System Purchase

HIGH-PERFORMANCE SCSI-2 CD-ROM DRIVE
$349

Chinon CDS-535 Internal Drive
- Dual Speed 300 KB/sec Transfer
- 280ms Access Time 256K Buffer
- MPC and High Sierra Compatible
- Multisession Photo CD Compatible
- Standard Audio-CD Compatible

IDE systems require SCSI Interface $79

486VL Magnum
8MB, 245MB, 14"

- Intel™486 processor with 8K cache
- 238 pin ZIF socket for Pentium™ based OverDrive™processors
- 256K ultra-fast 15ns SRAM cache
- 8MB 70ns RAM (up to 64MB)
- 7 Slots: 2 VESA (1 open), 7 ISA (6 open)
- Upgradeable Flash BIOS (Phoenix)
- Teac®dual drive 1.44MB 3.5", 1.2MB 5.25"
- Integrated 32-bit VESA local bus IDE interface with block mode transfer
- Maxtor®245MB 15ms IDE hard drive with block mode (300,000 hrs MTBF)
- Diamond SpeedStar Pro VLB accelerator 1MB RAM, Cirrus Logic 5426, 1280 x 1024
- 14" MAG LX1450 SVGA color monitor non-interlaced at 1024 x 768, .28dp
- 1 parallel, 2 serial ports (16550 compatible)
- Desktop chassis with "Tool Free" design
- 101-key enhanced keyboard
- Microsoft®Mouse 2.0 with Mouse Manager
- MS DOS 6, Enhanced Tools, Windows™3.1
- **Choice of one application software**

SAVE $100 433•DX **$1,899** Lease: $69/mo.

486VL WinStation
16MB, 345MB, 15"

- Intel 486 processor with 8K cache
- 238 pin ZIF socket for Pentium based OverDrive processors
- 256K ultra-fast 15ns SRAM cache
- 16MB 70ns RAM (up to 64MB)
- 7 Slots: 2 VESA (1 open), 7 ISA (6 open)
- Upgradeable Flash BIOS (Phoenix)
- Teac dual drive 1.44MB 3.5", 1.2MB 5.25"
- Integrated 32-bit VESA local bus IDE interface with block mode transfer
- Maxtor 345MB 14ms IDE hard drive with block mode (300,000 hrs MTBF)
- Diamond Viper VLB graphics accelerator 2MB VRAM, Weitek™ P9000, 1280 x 1024
- 15" MAG LX1564 SVGA color monitor non-interlaced at 1280 x 1024, .28dp
- 1 parallel, 2 serial ports (16550 compatible)
- Desktop chassis with "Tool Free" design
- 101-key enhanced keyboard
- Microsoft Mouse 2.0 with Mouse Manager
- MS DOS 6, Enhanced Tools, Windows 3.1
- **Choice of one application software**

SAVE $200 466•DX2 **$2,799** Lease: $102/mo.

[illegible]
16MB, 345MB, 17"

- Intel 486 processor with 8K cache
- 238 pin ZIF socket for Pentium based OverDrive processors
- 256K ultra-fast 15ns SRAM cache
- 16MB 70ns RAM (up to 64MB)
- 7 Slots: 2 VESA, 7 ISA (5 open)
- Upgradeable Flash BIOS (Phoenix)
- Teac dual drive 1.44MB 3.5", 1.2MB 5.25"
- **VL-bus 32-bit IDE caching controller with 4MB cache, .3ms, (up to 16MB)**
- Maxtor 345MB 14ms IDE hard drive with block mode (300,000 hrs MTBF)
- Diamond Viper VLB graphics accelerator 2MB VRAM, Weitek P9000, 1280 x 1024
- 17" MAG MX17F SVGA color monitor non-interlaced at 1280 x 1024, .26dp
- 1 parallel, 2 serial ports (16550 compatible)
- Desktop chassis with "Tool Free" design
- 101-key enhanced keyboard
- Microsoft Mouse 2.0 with Mouse Manager
- MS DOS 6, Enhanced Tools, Windows 3.1
- **Choice of one application software**

SAVE $200 466 DX2 **$3,699** Lease: $129/mo.

486VL MagServer
EISA-VESA, SCSI-2

- Intel 486 processor with 8K cache
- 238 pin ZIF socket for Pentium based OverDrive processors
- 256K ultra-fast 15ns SRAM cache
- **16MB 70ns RAM (up to 64MB)**
- 8 Slots: 2 VESA, 8 EISA (6 open)
- Upgradeable Flash BIOS (Phoenix)
- Teac dual drive 1.44MB 3.5", 1.2MB 5.25"
- VL-bus 32-bit bus mastering Fast SCSI-2 controller (up to seven devices)
- **Maxtor 1.2GB 9ms SCSI-2 hard drive up to 44MBits/sec (300,000 hrs MTBF)**
- Diamond SpeedStar Pro VLB accelerator 1MB RAM, Cirrus Logic 5426, 1280 x 1024
- 14" MAG LX1450 SVGA color monitor non-interlaced at 1024 x 768, .28dp
- 1 parallel, 2 serial ports (16550 compatible)
- Tower chassis with 7 drive bays (5 open)
- 101-key enhanced keyboard
- Microsoft Mouse 2.0 with Mouse Manager
- MS DOS 6, Enhanced Tools, Windows 3.1
- **Choice of one application software**

SAVE $400 466•DX2 **$3,799** Lease: $132/mo.

486VL WinServer
EISA-VESA, SCSI-2

- Intel 486 processor with 8K cache
- 238 pin ZIF socket for Pentium based OverDrive processors
- 256K ultra-fast 15ns SRAM cache
- **16MB 70ns RAM (up to 64MB)**
- 8 Slots: 2 VESA, 8 EISA (6 open)
- Upgradeable Flash BIOS (Phoenix)
- Teac dual drive 1.44MB 3.5", 1.2MB 5.25"
- VL-bus 32-bit bus mastering Fast SCSI-2 controller (up to seven devices)
- **Maxtor 540MB 9ms SCSI-2 hard drive up to 44MBits/sec (300,000 hrs MTBF)**
- Diamond Viper VLB graphics accelerator 2MB VRAM, Weitek P9000, 1280 x 1024
- 15" MAG LX1564 SVGA color monitor non-interlaced at 1280 x 1024, .28dp
- 1 parallel, 2 serial ports (16550 compatible)
- Tower chassis with 7 drive bays (5 open)
- 101-key enhanced keyboard
- Microsoft Mouse 2.0 with Mouse Manager
- MS DOS 6, Enhanced Tools, Windows 3.1
- **Choice of one application software**

SAVE $200 466•DX2 **$3,799** Lease: $132/mo.

[illegible]
4MB, 130MB, 14"

- Intel 486 processor with 8K cache
- 238 pin ZIF socket for Pentium based OverDrive processors
- 256K ultra-fast 15ns SRAM cache
- 4MB 70ns RAM (up to 32MB)
- 6 Slots: 2 VESA (1 open), 6 ISA (5 open)
- Teac 1.44MB 3.5" floppy drive
- Integrated 16-bit IDE interface
- Maxtor 130MB 14ms IDE hard drive with block mode (300,000 hrs MTBF)
- Diamond SpeedStar Pro VLB accelerator 1MB RAM, Cirrus Logic 5426, 1280 x 1024
- 14" MAG LX1450 SVGA color monitor non-interlaced at 1024 x 768, .28dp
- 1 parallel, 1 game, 2 serial ports
- Desktop chassis with "Tool Free" design
- 101-key enhanced keyboard
- Microsoft Mouse 2.0 with Mouse Manager
- MS DOS 6, Enhanced Tools, Windows 3.1
- **Choice of one application software**

SAVE $100 433 SX **$1,399** Lease: $51/mo.

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- NEXT DAY SHIPPING ON MOST SYSTEMS
- 30 DAY RISK-FREE MONEY BACK GUARANTEE
- ONE YEAR EXPRESS PARTS REPLACEMENT
- LIFETIME TOLL-FREE TECHNICAL SUPPORT
- ONE YEAR ON-SITE SERVICE OR SYSTEM REPLACEMENT

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CIRCLE 119 ON READER SERVICE CARD

Sigma Designs Inc.

Sigma Designs Ergo View 17

BY JOHN R. QUAIN

Although MAG InnoVision manufactures the Sigma Designs Ergo View 17 ($1,499 list), its differences with the MAG MX17F become apparent as soon as you turn it on. The Ergo View 17 is based on a Sony Trinitron tube, which gives it a vertically flat display and different image characteristics than MAG's Hitachi tube–based model.

The Ergo View's performance in 1,024-by-768 mode was above average, and its picture was pleasingly bright during objective and subjective testing. We saw no pincushioning or misconvergence. But sharpness between light and dark edges on-screen was below average, and the Ergo View posted a less-than-desirable MTF score of 36 percent. Users will notice a slight lack of image detail, particularly in high-contrast graphics.

Sigma Designs Ergo View 17

In general, the Ergo View 17 is an above-average monitor with some minor shortfalls in high-resolution modes. Though we found the monitor to be accurate for the most part, with good whites and solid color saturation, it wasn't able to compete with the top performers in this roundup.

▶ FACT FILE

Sigma Designs Ergo View 17
Sigma Designs Inc., 47900 Bayside Pkwy., Fremont, CA 94538; 800-845-8086, 510-770-0100; fax, 510-770-2640.
List price: *$1,499.*
Circle 505 on reader service card

Sony Electronics Inc.

Sony CPD-1730

BY JOHN R. QUAIN

Among the monitors we tested, the Sony CPD-1730 offers the best image. Built around the company's own vertically flat Trinitron tube, this incarnation has gained a sharper focus with a new electron gun and a deflection yoke design. Also new are digital controls that replace the analog thumb wheels seen in Sony's earlier 17-inch model and a much-improved list price of $1,329.95 (the earlier incarnation listed for $1,760).

During testing, the CPD-1730 had the brightest picture in 1,024-by-768 mode, and maximum usable brightness was an outstanding 43.0 foot-lamberts. It also showed the least amount of misconvergence among all the tested monitors.

The only less-than-ideal test result was its pincushioning-error score. But Sony provides a full suite of digital-image

Sony CPD-1730

controls, including pincushioning and barrel-distortion buttons that can tune each edge of the display independently.

The CPD-1730 led the pack of 17-inch monitors with its clean, crisp display and competitive price.

▶ FACT FILE

EDITORS' CHOICE Sony CPD-1730
Sony Electronics Inc., 3300 Zanker Rd., San Jose, CA 95134; 800-352-7669, 408-894-0225; fax, 408-955-5171.
List price: *$1,329.95.*
Other models: *Sony CPD-1604S, $1,219.95.*
Circle 506 on reader service card

Swan 17LR

Swan Technologies Inc.

Swan 17LR

BY DON CRABB

With a 0.28-mm dot pitch, digital controls, a good shadow mask tube, and 13 user and preset memories, the Swan 17LR ($999 list) exhibited good but not stellar performance. It suffered from some pincushion distortion that we could not correct.

The 17LR scored reasonably well on our tests. Its MTF score was 44.5 percent (roughly 6 percentage points above the mean of 38.6 percent), while its misconvergence result was 0.15 mm, which ranked twenty-first. But thanks to the 17LR's admirable dot pitch, this misconvergence wasn't noticeable when using Windows.

We found some momentary flashing and bounce when changing from full-screen DOS to Windows. The image was decent, with good readability, some slight bottom bowing, and some slight center flicker.

But considering the cost of the Swan 17LR, its results were good. For a relatively low price, this monitor offers very good brightness and contrast, along with good color depth and purity. The screen's silica coating also cuts glare reasonably well.

▶ FACT FILE

Swan 17LR
Swan Technologies Inc., 3075 Research Dr., State College, PA 16801; 800-382-4924, 814-234-2236; fax, 814-237-4450.
List price: *$999.*
Circle 507 on reader service card

SUMMARY OF FEATURES

17-Inch Monitors

In alphabetical order by company

■ = YES □ = NO

	AcerView 76i	Addonics C172A/LR	Amax Impression7	Amdek AM/817	AOC CM-747	ASTVision 7L
List price	$999.00	$995.00	$899.00	$1,139.00	$999.00	$995.00
Tube manufacturer	Hitachi	Matsushita	Hitachi	Toshiba	Hitachi	Hitachi
Tube size (diagonally, in inches)	17	17	17	17	17	17
Active screen size (inches)	16.3	16.2	15.6	16	15.8	16
Dimensions (HWD, in inches)	16 x 16.2 x 16.7	15.8 x 16.3 x 16.7	16.5 x 16.3 x 19.7	17 x 16.5 x 17.5	16 x 16.7 x 17.5	15.6 x 16.2 x 17.3
Weight (pounds)	44	44.8	50.6	46.7	44.9	41.3
Length of power cable (inches)	48	63	36	70	72	65
Adapter cable included	Captive to 15-pin	Captive to 15-pin	Captive to 15-pin	BNC-5 to 15-pin	Captive to 15-pin	Captive to 15-pin
FCC certification class	B	B	B	B	A	B
MPR II-compliance claimed	■	■	□	□	■	■
120-/240-volt switching	■	■	■	■	■	■
Operational Features						
Fixed or variable frequency	Variable	Variable	Variable	Variable	Variable	Variable
Video bandwidth (MHz)	110	110	120	125	135	110
Vertical scanning frequency (Hz)	50–90	50–90	50–120	40–90	43–100	50–90
Horizontal scanning frequency (kHz)	31–64	31–64	30–68	30–76	30–82	30–64
Maximum noninterlaced resolution (pixels)	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024
Maximum vertical refresh rates (Hz):						
1,280 x 1,024	60	60	60	70	74	60
1,024 x 768 noninterlaced	72	76	70	86	87	76
Super VGA (800 x 600)	72	76	72	86	87	76
VGA (640 x 480)	60	76	60	90	87	76
Phosphor persistence	Medium-short	Medium-short	Medium-short	Medium	Medium-short	Medium-short
Dot pitch or aperture grill pitch (mm)	0.28	0.28	0.26	0.26	0.28	0.28
Power consumption (watts)	140	130	130	130	130	140
Microprocessor included	■	■	■	■	■	■
Signal Compatibility						
MCGA/Hercules	■■	■□	■■	□□	□■	□■
Mac II/Apple II GS	■■	■□	■□	■■	■■	□□
Controls						
Analog or digital	Digital	Digital	Digital	Digital	Digital	Digital
Brightness/Contrast	■■	■■	■■	■■	■■	■■
Color matching	■	■	□	□	■	□
Horizontal/vertical position	■■	■■	■■	■■	■■	■■
Horizontal/vertical size	■■	■■	■■	■■	■■	■■
Pincushioning/Barrel distortion	■■	■■	■■	□□	■■	■□
Degaussing	■	■	■	■	■	■
Customer Service						
Toll-free technical support	■	■	□	■	■	■
Telephone technical support hours (eastern time)	5:00–7:00 M–F, 7:00–4:00 Sat.	11:00–9:00 M–F	10:00–8:30 M–F, 11:00–6:30 Sat.	11:00–7:00 M–F	9:30–8:30 M–F	24 hours a day, 365 days a year
24-hour BBS	■	□	■	■	□	■
Warranty	1 year	2 years	1 year	1 year	1 year	1 year

N/A—Not applicable. The product does not have this feature

CONTINUES

Compaq QVision 170 Color Monitor	E-Machines ColorPage T16 II	IBM PS/ValuePoint 6317	Idek MF-8317	KFC CA 1713	Liberty CL-9117	MAG MX17F	Nanao Flexscan F550i
$1,145.00	$1,499.00	$1,165.00	$1,395.00	$1,195.00	$1,049.00	$1,499.00	$1,499.00
Zenith	Sony	Either Hitachi or Toshiba	Hitachi	Hitachi	Toshiba	Hitachi	Mitsubishi
17	17	17	17	17	17	17	17
15.7	16	16.1	16.3	16	15.9	15.5	15.8
17 x 17.8 x 17.5	16.5 x 16.4 x 19.2	16.3 x 16.1 x 17.1	16.3 x 16.1 x 16.5	16.2 x 16.6 x 16.6	15.3 x 16.2 x 17.1	17 x 16.3 x 18.5	15.9 x 15.7 x 18
56.5	54.5	48	47.3	40	49.5	51.9	48.7
72	60	72	72	72	72	72	83
BNC-5 to 15-pin	BNC-3 to 15-pin	Captive to 15-pin	Captive to 15-pin	Captive to 15-pin	BNC-5 to 15-pin	15-pin to 15-pin	Captive to 15-pin
B	A	B	A	B	B	B	B
■	■	■	■	□	□	■	■
■	■	■	■	■	■	■	□
Variable	Variable	Variable	Variable	Variable	Variable	Variable	Variable
75	120	110	120	80	130	120	80
50–100	50–120	50–130	50–90	50–90	50–90	50–120	55–90
32–58	30–68	30–64	30–65	30–64	30–75	30–68	30–65
1,024 x 768	1,024 x 768	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024
N/A	N/A	60	60	60	70	60	60
72	75	75	76	70	75	76	80
72	75	75	90	72	75	85	90
75	75	75	90	73	75	85	90
Medium-short	Medium-short	Medium	Medium-short	Medium-short	Medium-short	Medium-short	Medium-short
0.26	0.25	0.28	0.26	0.26	0.26	0.26	0.28
173	110	140	120	120	140	110	120
■	■	■	■	■	■	■	■
■■	□□	■■	□□	□□	■□	■□	□□
□□	■□	□□	■■	■■	■■	■□	■□
Digital	Digital	Digital	Digital	Digital	Digital	Digital	Digital
■■	■■	■■	■■	■■	■■	■■	■■
□	□	□	■	□	□	□	■
■■	■■	■■	■■	■■	■■	■■	■■
■■	■■	■■	■■	■■	■■	■■	■■
□□	■■	■■	■■	□□	■■	■■	■■
□	□	□	■	□	□	■	■
■	■	■	■	■	■	■	■
24 hours a day, 365 days a year	9:00–9:00 M–F	8:00–5:00 M–F	8:30–5:00 M–F	11:30–8:00 M–F	11:30–8:15 M–F	11:00–8:00 M–F	11:30–8:00 M–F
■	■	■	□	□	□	□	■
1 year	1 year	1 year	2 years	1 year	1 year	1 year; 2 years on CRT	1 year

SUMMARY OF FEATURES

In alphabetical order by company

■ = YES □ = NO

	Nanao Flexscan F550i-W (PC MAGAZINE EDITORS' CHOICE)	NEC MultiSync 5FG (PC MAGAZINE EDITORS' CHOICE)	NEC MultiSync 5FGe	Optiquest 4000DC	PanaSync/Pro C1795E	Philips 1762DT FastRefresh/17
List price	$1,599.00	$1,355.00	$1,155.00	$999.00	$1,579.00	$1,299.00
Tube manufacturer	Mitsubishi	NEC	NEC	Matsushita	Matsushita	Sony
Tube size (diagonally, in inches)	17	17	17	17	17	16
Active screen size (inches)	15.7	15.6	15.6	16.2	15.6	16
Dimensions (HWD, in inches)	16.3 x 16.1 x 17.5	17.8 x 16.4 x 19.8	17.8 x 16.4 x 19.8	15.6 x 16.3 x 16.8	16.6 x 15.8 x 17.8	16.7 x 16.6 x 17.3
Weight (pounds)	49.4	56.2	53.7	41	45.2	49.3
Length of power cable (inches)	83	72	72	72	72	81
Adapter cable included	15-pin to 15-pin	BNC-5 to 15-pin	Captive to 15-pin	Captive to 15-pin	BNC-5 to 15-pin	15-pin to 15-pin
FCC certification class	B	A	B	B	B	B
MPR II-compliance claimed	■	■	■	□	■	■
120-/240-volt switching	■	□	□	■	□	■
Operational Features						
Fixed or variable frequency	Variable	Variable	Variable	Variable	Variable	Variable
Video bandwidth (MHz)	80	135	80	110	130	110
Vertical scanning frequency (Hz)	55–90	55–90	55–90	50–90	50–90	50–100
Horizontal scanning frequency (kHz)	27–65	27–79	31–62	31–64	30–79	30–64
Maximum noninterlaced resolution (pixels)	1,280 x 1,024	1,280 x 1,024	1,024 x 768	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024
Maximum vertical refresh rates (Hz):						
1,280 x 1,024	60	74	N/A	60	74	60
1,024 x 768 noninterlaced	80	76	76	76	72	80
Super VGA (800 x 600)	90	76	76	76	72	100
VGA (640 x 480)	90	76	75	76	72	100
Phosphor persistence	Medium-short	Medium-short	Medium-short	Medium-short	Medium-short	Medium-short
Dot pitch or aperture grill pitch (mm)	0.28	0.28	0.28	0.28	0.28	0.25
Power consumption (watts)	120	155	120	140	140	120
Microprocessor included	■	■	■	■	■	■
Signal Compatibility						
MCGA/Hercules	□□	□□	□□	□□	□□	□□
Mac II/Apple II GS	■□	■□	■□	■■	■■	■□
Controls						
Analog or digital	Digital	Digital	Digital	Digital	Digital	Digital
Brightness/Contrast	■■	■■	■■	■■	■■	■■
Color matching	■	■	■	■	■	□
Horizontal/vertical position	■■	■■	■■	■■	■■	■■
Horizontal/vertical size	■■	■■	■■	■■	■■	■■
Pincushioning/Barrel distortion	■■	■■	■■	■■	■■	■■
Degaussing	■	■	■	■	■	■
Customer Service						
Toll-free technical support	■	■	■	■	■	■
Telephone technical support hours (eastern time)	11:30–8:00 M–F	11:30–11:00 M–F	8:30–8:00 M–F	11:00–8:00 M–F	9:00–5:00 M–F	8:00–9:00 M–F
24-hour BBS	■	■	■	□	□	■
Warranty	1 year	3 years	3 years	15 months	1 year	1 year

N/A—Not applicable. The product does not have this feature

CONTINUES

Relisys RE-1764	Sampo AlphaScan 17/E	Samsung SyncMaster 4 Plus	Samsung SyncMaster 5c	Samtron SC-726V	Sceptre CL-617	Seiko CM1760LR	Sigma Designs Ergo View 17
$1,395.00	$1,495.00	$1,299.00	$1,399.00	$1,199.00	$1,395.00	$1,449.00	$1,499.00
Hitachi	Hitachi	Toshiba	NEC	Toshiba	Hitachi	Sony	Sony
17	17	17	17	17	17	17	17
15.9	15.8	15.9	15.9	15.8	15.9	16.1	16.1
16 x 16.3 x 18.3	17 x 16 x 17.5	17.9 x 16.4 x 17.4	17.4 x 16.4 x 17.7	15.6 x 16 x 16.4	15.8 x 16.3 x 17.3	15.5 x 16 x 17.5	16.6 x 16.1 x 19.6
45.7	49.5	48.3	47.4	48.6	41.1	50	55
72	60	72	72	72	70	72	40
Captive to 15-pin	Captive to 15-pin	Captive to 15-pin	Captive to 15-pin	Captive to 15-pin	Captive to 15-pin	Captive to 15-pin	15-pin to 15-pin
B	B	B	B	B	B	A	B
□	■	□	□	□	□	■	■
■	■	■	■	■	■	□	■
Variable	Variable	Variable	Variable	Fixed	Variable	Variable	Variable
110	100	110	110	75	110	100	120
50–120	50–90	45–90	45–90	56–72	50–90	50–90	50–120
30–64	30–82	30–65	30–65	32–56	30–66	31–64	30–68
1,280 x 1,024	1,600 x 1,280	1,280 x 1,024	1,280 x 1,024	1,024 x 768	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024
60	76	60	60	N/A	60	60	64
72	76	78	78	70	72	72	85
72	72	72	72	72	72	75	106
72	67	72	72	72	72	75	120
Medium-short	Medium-short	Medium-short	Medium-short	Medium	Medium-short	Medium-short	Medium-short
0.31	0.28	0.31	0.26	0.26	0.26	0.25	0.25
130	130	140	140	100	120	150	130
□	■	■	■	□	■	□	■
□□	□□	□□	□□	□□	□□	□□	■■
□□	■■	■■	■■	□□	■■	■■	■□
Analog	Analog	Digital	Digital	Analog	Digital	Analog	Digital
■■	■■	■■	■■	■■	■■	■■	■■
□	■	□	□	□	□	□	□
■■	■■	■■	■■	■■	■■	■■	■■
■■	■■	■■	■■	■■	■■	■■	■■
□□	■■	■■	■■	□□	■■	□□	■□
■	■	■	■	■	■	■	■
■	□	■	■	□	■	■	□
11:00–8:00 M–F	8:00–5:00 M–F	9:00–5:30 M–F	9:00–5:30 M–F	11:30–8:30 M–F	11:30–8:30 M–F	10:00–8:00 M–F	N/A
■	□	■	■	□	■	■	■
1 year	2 years	1 year	1 year	1 year	2 years on parts 1 year on labor	1 year	1 year

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CIRCLE 071 ON READER SERVICE CARD

SUMMARY OF FEATURES

ENDS

Listed in alphabetical order by company

■ = YES □ = NO

	Sony CPD-1730 (PC MAGAZINE EDITORS' CHOICE)	Swan 17LR	Toshiba OmniSync CW P1762682	ViewSonic 7	ViewSonic 17	ZDS ZCM-1790
List price	$1,329.95	$999.00	$1,699.00	$1,099.00	$1,299.00	$999.00
Tube manufacturer	Sony	Matsushita	Toshiba	Matsushita	Matsushita	Zenith
Tube size (diagonally, in inches)	17	17	16	17	17	17
Active screen size (inches)	16.1	15.9	16	16	15.6	15.8
Dimensions (HWD, in inches)	16.9 x 16 x 17.3	16.8 x 16.3 x 17	16.8 x 15.5 x 18	16.6 x 16.3 x 17.1	16.3 x 16.3 x 17.6	16.6 x 17.9 x 18
Weight (pounds)	43.2	42.9	49	43.1	42.4	56
Length of power cable (inches)	60	72	72	72	72	72
Adapter cable included	Captive to 15-pin	Captive to 15-pin	BNC-5 to 15-pin ($21)	Captive to 15-pin	BNC-5 to 15-pin	Captive to 15-pin
FCC certification class	B	B	A	B	B	B
MPR II-compliance claimed	■	■	■	■	■	■
120-/240-volt switching	■	■	■	■	■	■
Operational Features						
Fixed or variable frequency	Variable	Variable	Variable	Variable	Variable	Variable
Video bandwidth (MHz)	60	86	120	86	135	75
Vertical scanning frequency (Hz)	55–110	50–90	55–90	50–90	50–90	52–97
Horizontal scanning frequency (kHz)	28–58	30–64	30–82	30–64	30–82	31–61
Maximum noninterlaced resolution (pixels)	1,024 x 768	1,280 x 1,024	1,600 x 1,280	1,280 x 1,024	1,600 x 1,280	1,024 x 768
Maximum vertical refresh rates (Hz):						
1,280 x 1,024	N/A	60	75	60	76	N/A
1,024 x 768 noninterlaced	72	74	72	76	76	75
Super VGA (800 x 600)	72	76	72	76	76	97
VGA (640 x 480)	75	76	72	76	76	97
Phosphor persistence	Medium-short	Medium-short	Medium-short	Medium-short	Medium-short	Medium-short
Dot pitch or aperture grill pitch (mm)	0.25	0.28	0.26	0.28	0.28	0.26
Power consumption (watts)	130	120	130	130	140	175
Microprocessor included	■	■	■	■	■	■
Signal Compatibility						
MCGA/Hercules	■□	□□	□□	□□	□□	■■
Mac II/Apple II GS	■□	■□	■■	■■	■■	■■
Controls						
Analog or digital	Digital	Digital	Digital	Digital	Digital	Digital
Brightness/Contrast	■■	■■	■■	■■	■■	■■
Color matching	□	□	■	□	■	□
Horizontal/vertical position	■■	■■	■■	■■	■■	■■
Horizontal/vertical size	■■	■■	■■	■■	■■	■■
Pincushioning/Barrel distortion	■■	■□	■□	□□	□□	□□
Degaussing	■	□	■	□	■	□
Customer Service						
Toll-free technical support	□	■	■	■	■	■
Telephone technical support hours (eastern time)	N/A	9:00–9:00 M–F, 9:00–5:00 Sat., Sun., holidays	10:00–6:00 M–F	11:00–8:00 M–F	11:00–8:00 M–F	8:00–12:00 M–F
24-hour BBS	■	■	■	■	■	■
Warranty	1 year; 2 years on CRT	2 years	1 year	1 year	1 year	1 year

N/A—Not applicable. The product does not have this feature

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SO ADVANCED IT EVEN TURNS ITSELF OFF.

PC MAGAZINE EDITORS' CHOICE
March 16, 1993
FlexScan F340iW

1993 W 100 WINDOWS MAGAZINE ANNUAL WIN AWARD
FlexScan F550i

Nanao, the technical leader in monitors has done it again. In addition to being the top choice of today's CAD/CAM, DTP and Windows users, Nanao's award-winning FlexScan monitors now have a remarkable energy-saving system — PowerManager.

PowerManager works with all green computer systems including VESA DPMS (Display Power Management Signaling). But users don't have to own a new green computer in order to take advantage of the PowerManager to save energy. Our PowerManager works with any existing PCs with a screen saver software, including Windows 3.1 and After Dark. Activating when the blank screen of the screen saver appears, PowerManager cuts operating power to less than 8% of total consumption. It also automatically powers the monitor down to a stand-by mode when the computer is turned off. The PowerManager can save users as much as $63 per year on utility bills (Source: E Source). PowerManager has placed Nanao at the forefront of the Environmental Protection Agency's Energy Star Program.

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PC MAGAZINE MVP WINNER
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WINDOWS MAGAZINE W 1993 RECOMMENDED
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CIRCLE 008 ON READER SERVICE CARD

Toshiba America Consumer Products Inc.

Toshiba OmniSync CW P1762682

BY DON CRABB

The Toshiba OmniSync CW P1762682 ($1,699 list) provides an excellent image, with pure and deep colors.

The component pedigree of the OmniSync's components can't be faulted: a flat square tube; an Invar shadow mask; a multilayer, antistatic, antiglare screen; and microprocessor-driven digital controls. Unfortunately, those controls are difficult to figure out and use.

The display showed only slight pincushioning in high-resolution modes, and the pincushioning control easily adjusted this out. It also exhibited practically no visible distortion and synced well even in 1,280-by-1,024 resolution.

When switching between full-screen DOS and Windows, we found the screen bounced and took 2 full seconds to lock down—a troubling occurrence.

Overall, however, the OmniSync, with its small dot pitch and low geometric distortion, is a pleasure to use. If it were priced lower and had easier-to-use controls, it would have been in the top group. *As we went to press, Toshiba withdrew this monitor from the market.*

▶ FACT FILE

Toshiba OmniSync CW P1762682
Toshiba America Consumer Products Inc., 1010 Johnson Dr., Buffalo Grove, IL 60089-6900; 800-253-5429, ext. 321, 708-541-9400; fax, 708-541-1927.
List price: *$1,699.* Other models: *Toshiba OmniSync CT P172665, $1,499.*

Circle 508 on reader service card

Toshiba OmniSync CW P1762682

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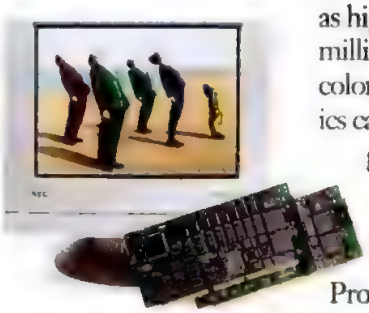

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CIRCLE 234 ON READER SERVICE CARD

ViewSonic 17, ViewSonic 7

ViewSonic

ViewSonic 7
ViewSonic 17

BY JOHN R. QUAIN

Few pairs of 17-inch monitors could better illustrate the differences that separate the high end from the midrange than the ViewSonic 17 and the ViewSonic 7. The $1,299 ViewSonic 17 is a high-performance model that includes BNC and VGA inputs, color correction, and fancy controls. For $200 less, there's the ViewSonic 7, an older model with midrange performance and fewer amenities.

The basic design of each model is the same. Both use a Matsushita tube, both are MPR II–compliant, and both have digital controls with 13 preset standard video modes. Where they differ is in features and performance.

HIGH-END MODEL

The ViewSonic 17 is generally more powerful and feature-rich than the ViewSonic 7. It supports higher resolutions (up to 1,600-by-1,280 at 60 Hz) and will display a noninterlaced 1,280-by-1,024 image at an eye-saving 76-Hz vertical refresh rate (the ViewSonic 7 will only support 60 Hz at this resolution). Unlike the ViewSonic 7, the ViewSonic 17 also includes a manual degaussing button, color temperature, and red/green/blue value controls.

The feature-laden ViewSonic 17 was one of the performance leaders on our tests. In 1,024-by-768 mode, image sharpness was good, helping secure an MTF score that ranked among the best. Image brightness was also excellent. Measured maximum usable brightness on this model was second only to that of the Sony CPD-1730.

Subjective tests, however, exposed a few faults. Some images yielded discernible jitter, especially in 800-by-600 and 1,024-by-768 modes.

OLDER SIBLING

The older and less expensive ViewSonic 7 is intended for users with simpler needs. In terms of performance, the ViewSonic 7 lagged behind its more expensive sibling. Its image in 1,024-by-768 mode was not as sharp, and it earned a below-average MTF score on our test. Also, its display was not as bright as the ViewSonic 17's, and we could not turn up its brightness control without causing some blooming.

The ViewSonic 7's maximum usable brightness was limited to 25.1 foot-lamberts, considerably less than the ViewSonic 17's but about average for this group.

These two monitors represent different ends of the 17-inch-monitor spectrum. The high-end ViewSonic 17 offers better performance, while the midrange ViewSonic 7 manages the basics for a reasonable price.

▶ FACT FILE

ViewSonic 7
ViewSonic 17
ViewSonic, 20480 Business Pkwy., Walnut, CA 91789; 800-888-8583, 909-869-7976; fax, 909-869-7958.
List price: *ViewSonic 7, $1,099; ViewSonic 17, $1,299.*
Circle 509 on reader service card

ZDS ZCM-1790

Zenith Data Systems

ZDS ZCM-1790

BY BRUCE BROWN

While the Zenith Data Systems ZCM-1790 (which has a list price of $999) earned only an average overall score, it had the best glare prevention of all the tested monitors.

The ZCM-1790 uses Zenith Data System's 0.26-mm dot pitch tube with a 15.75-inch diagonal active screen area. The flat screen's Flat Tension Mask contributes to a glare prevention that is so far superior to the coatings and etchings that are used on most of the other monitors we've seen to date as to be in its own class.

The ZCM-1790's Flat Tension Mask contributes to a glare prevention that is so superior to the coatings and etchings used on most other monitors as to be in its own class.

In objective testing, the ZCM-1790 proved to be an average performer. It tied for first place in MTF testing, and posted an above-average misconvergence score and an average pincushioning-error score. There was slight moire patterning in 800-by-600 mode but a significant amount in 1,024-by-768 resolution. The ZCM-1790 does not support 1,280-by-1,024 noninterlaced mode. It runs in 1,280-by-1,024 interlaced mode at 87 Hz (with the flicker of interlaced video).

In sum, the ZDS ZCM-1790 is a fine monitor that provides users with exceptional glare control. In this field of 34 monitors, the ZCM-1790 earned an average ranking. □

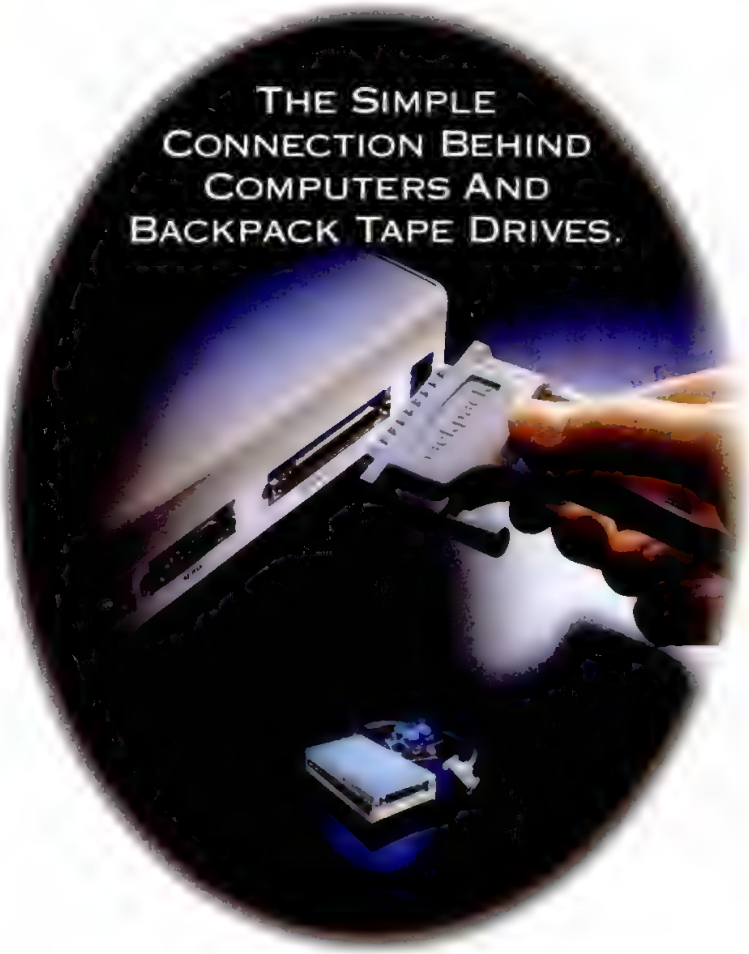
▶ FACT FILE

ZDS ZCM-1790

Zenith Data Systems, 2150 E. Lake Cook Rd., Buffalo Grove, IL 60089; 800-553-0331, 708-808-5000; fax, 800-472-7211, 708-808-4434.

List price: *$999.*

Circle 510 on reader service card



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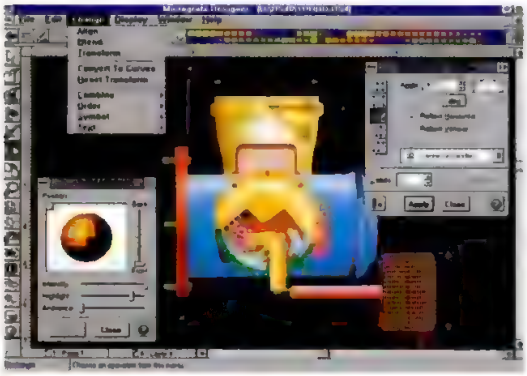

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DESKTOP PRESENTATIONS

The Sound and the Fury

Multimedia moves to the boardroom thanks to the latest generation of business presentation software.

Desktop presentations are paradoxical in that they have everything and nothing in common with the traditional slide-based presentation metaphor. Everything, because in many ways they are simply the next generation—a replacement for the overheads, slides, and handouts that comprise the bulk of today's presentation media. Nothing, because they can also replace *you*—the presenter—and can require that you have an almost entirely different set of skills.

For these reasons, we have chosen to look at the software capable of generating electronic presentations in two groups. The first set of products, Asy-

by Lori Grunin

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Macromedia Action! 240
Microsoft PowerPoint 267
SoftCraft Presenter 246

Illustrations by Richard Tuschman

metrix Corp.'s Compel, Version 1.0 ($295), Macromedia's Action!, Version 2.5 ($495), and SoftCraft Presenter, Version 2.0 ($595), are specifically designed to integrate sound, video, and animation into the typical text- and bar-chart extravaganza. The various media elements take the place of your hands for emphasizing points. These packages can speak for themselves, and thus can be used for generating "presenterless" presentations, such as those found in kiosks.

The second group of products, Lotus's Freelance Graphics for Windows, Release 2.0 ($495), Microsoft PowerPoint, Version 3.0 ($495), and Software Publishing Corp.'s Harvard Graphics for Windows, Version 1.03 ($595), are the first three traditional slide-based presentation graphics mainstays to begin supporting multimedia. Their skills at doing so are rudimentary enough, however, that electronic delivery usually means simple PC-based slide shows with occasional sound or video clips for emphasis, rather than full-blown multimedia events. The multimedia features are designed to allow business users to be creative.

To be considered a desktop presentation product for the purposes of this story, a package needed to be able to create data and text charts and integrate sound files (MIDI or .WAV), video clips (Macromedia Director clips, Microsoft .AVI files, or QuickTime Movies), and animations (Autodesk .FLI/.FLC files) into a presentation. One product, Curtain Call ($199.95; Brown Wagh, 800-451-0900) was less a presentation package than multimedia-capable video-titling software. Another product, Super Show & Tell, Version 1.0 ($149; Ask Me Multimedia Center Inc., 612-531-0603), had capabilities too primitive to warrant serious consideration here, and thus was dropped. The Microsoft Windows version of Gold Disk's Astound, now available only on the Macintosh, was not set to ship until after our testing period.

Once upon a time, the hardest choices you needed to make while creating a presentation were which font to use, which type of chart best described your data, and later, which color scheme to pick and whether or not to use clip art. Introducing new media into the picture greatly expands your choices—and your burdens.

For instance, instead of using a simple bullet chart to convey next year's corporate goals, you could use animated flying bullets to emphasize your points, a voice-over to read them, or a video clip of the company president to replace the chart entirely. When used appropriately, these tools can greatly increase the effectiveness and persuasiveness of your message. But when misused, these media can distract, confuse—or worse—annoy your audience. (For advice on using media wisely, see the sidebar "Tips for a Better Presentation.")

Presentation products try to allay your fear of multimedia in a variety of ways. The first is via the tried-and-true method used by traditional presentation graphics packages: predefined templates and masters. Not surprisingly, this approach

Suitability To Task: Desktop Presentations

The three packages in this review are all designed to integrate sound, video, and animation into the familiar text- and bar-chart environment. The differences lie in the organizing metaphor on which the packages rely, and in how much flexibility they give you in controlling your multimedia elements. The desktop presentation package you choose should depend on how creative you want to be, how deep you want to plunge into the multimedia pool, and how you intend to deliver your finished presentation.

In evaluating **simple multimedia presentation** creation, we looked at how easy it is for a first-time or infrequent presenter to create a presentation with a limited number of multimedia elements using the productivity-enhancement tools included in the package. Important factors here were ease of use, quality of documentation and tutorials, and the attractiveness and ease with which you can incorporate templates, clip art, and clip media into your presentation.

In evaluating **complex multimedia presentation** capabilities, we focused on how useful a package is for creating a full-fledged multimedia desktop presentation. Here the emphasis was on creative control rather than ease of use. Important factors included: how well a package handles imported multimedia elements and how much control it affords the user over those elements, how robust its OLE support is, and how much flexibility it gives the user who wants to customize existing masters and templates. Also important here were the package's handling of text and data charts, the attractiveness and flexibility of its special effects and between-slide transitions, and the depth and performance of its drawing tools. Extra features such as the ability to jump to another slide or launch another application using hyperlinks could improve a package's score.

SUITABILITY TO TASK

Product Name

	POOR	FAIR	GOOD	EXCELLENT
Simple multimedia presentation	●	○	○	○
Complex multimedia presentation	●	●	○	○
Printed output	●	●	●	○
Electronic delivery/ portable output	●	●	●	●

To score well on **printed output**, a package had to turn out high-quality output on both black-and-white and color printers. Also important were the flexibility of the printing options for generating handouts and speaker notes. How successful a package was at remapping colors to black and white, and how it handled multimedia objects were also key factors. The ability to customize printouts by specifying the page layout, placing multiple slides on a page, or allowing you to add captions or explanatory text were bonuses.

In evaluating **electronic delivery/portable output**, we looked at a package's skill at creating a runtime version of a presentation and the flexibility of its on-screen delivery. Important criteria for scoring well here included whether a package automatically includes all the necessary multimedia files in the runtime, if it compresses those files to make them more portable, how much control it affords the user over the playing of the finished presentation, and the overall quality of the on-screen presentation. The ability to create a small, efficient runtime was a key to success in this category.

Our Contributors: JOHN MOORE is a staff editor at *PC Magazine*. LORI GRUNIN, JAMES KARNEY, ROCK MILLER, and STEPHEN W. PLAIN are frequent contributors to *PC Magazine*. JEFF GREENBERG is a California-based free-lance writer and computer consultant. GAYLE C. EHRENMAN was the associate editor in charge of this story, and JEFF MACE was the project leader.

yields mixed results; it's much harder to standardize the placement of an audio or video clip, which is context-sensitive, than it is to standardize a font choice. On the other hand, predefined animated backgrounds, such as those used by Action!, can go a long way toward livening up your presentation.

Just as presentation graphics products stimulated the birth of the clip-art industry, desktop presentations have expanded the market for canned goods known as clip media: static clip art, sound and video clips, and animations. And just as traditional presentation graphics products offered traditional clip art as part of the package, this new breed of presentation tool includes a clip-media sampler. But there are limited uses for clip media. To be truly helpful, the media you use should be tailored to your presentation, and an entire industry of content-creation products has sprung up in order to make this possible. An offshoot of this group comprises what we call "multimedia servers," products that let you quickly assemble a series of multimedia images and incorporate them into other applications. We look at these products in "Adding Media to Your Message."

Audio and video capture boards are becoming relatively inexpensive, and their quality and ease of use increases daily. (For reviews of audio boards, see "Sound Boards: Coming of Age" in the April 27, 1993, issue of *PC Magazine*. For a discussion of video capture options and technology, see "Desktop Video: A Window on the Future" in the May 11, 1993, issue of *PC Magazine*.) Products such as Gold Disk's Animation Works Interactive ($495; Gold Disk Inc., 800-465-3375) and Autodesk Animator Pro ($795; Autodesk Inc., 800-525-2763) provide tools for creating animations to import.

CAVEAT PRODUCER

Even if you have all the requisite production skills and tools for creating whiz-bang presentations, you still need to deal with the limitations of your production environment and the products' shortcomings in dealing with those limitations. While your playback hardware needn't be as high-powered as your production hardware, the ideal delivery system—a 486 with accelerated video and sound cards—is still more than you find on the average desktop.

The most conspicuous problem that you'll probably face—one you won't realize you have if your production system has a high- or true-color graphics adapter, but your playback system operates in 256-color mode—is palette conflicts and shifts. These occur when the palette of the current image contains different colors than that of the subsequent image. The result is at best an ugly flash of a seemingly random image during a transition. At worst, the subsequent image either takes on the palette of the first image or changes the presentation palette until the next palette shift. Imported or OLE-linked bitmaps, animations, and videos all bring in their own palettes. So you'll have to use a tool such as the Palette Editor that ships with Microsoft's Video for Windows to derive a super-palette for your imported visuals.

PC MAGAZINE ▶ EDITORS' CHOICE

- **Macromedia Action!**

If you only want to create a quick and dirty bullet chart, look elsewhere. But if you're looking to add some multimedia magic to your presentation, look no further than Macromedia's Action!, Version 2.5. Thanks to its powerful synchronization tools, this $495 package makes it a breeze to combine sound, video, and animation into professional-looking electronic presentations. While the other packages in this roundup rely on a traditional slide-based metaphor for creating presentations, Action! uses a timeline, which makes it possible to fine-tune the interaction of multimedia elements precisely. In addition to its Timeline feature, which shows individual scenes, the package includes a Scene Sorter that gives you an overview of the presentation, complete with scene-to-scene transitions and flow logic, and a Content List that displays all the elements of the presentation organized by scene.

Those users who are more interested in performing traditional presentation tasks, such as creating hard-copy speakers' notes and handouts, will be woefully disappointed by Action!'s anemic printing capabilities.

SoftCraft Presenter, Version 2.0 ($595), goes further toward integrating multimedia and traditional presentation features into a package that is capable but somewhat hard to use. The major deficiencies in this presentation powerhouse are a poorly organized interface that makes using the package more complicated than it needs to be, and lack of a timeline, which makes synchronizing multimedia elements rather difficult.

Asymetrix Corp.'s Compel, Version 1.0 ($295), looks like a traditional presentation product but offers some well-selected and well-implemented multimedia capabilities, and perhaps the most well-organized interface of the bunch. Unfortunately, it suffers from some Version 1.0 glitches that inhibit its performance.

The strength of the traditional presentation packages is still producing attractive slide-based presentations in a hurry. The three we look at here—Freelance Graphics for Windows, Version 2.0 ($495), Microsoft PowerPoint, Verison 3.0 ($495), and Software Publishing Corp.'s Harvard Graphics for Windows, Version 1.03 ($595)—have all started to add multimedia capabilities, but these are limited at best. Stick to these packages for slide- and hard copy–based presentations with just a few animations or sound bites thrown in.

Also keep in mind that these desktop presentation products can't compare with their hard copy–oriented predecessors—which have benefited from several years of usability studies—for generating presentations quickly and painlessly the first time and every time. Compel and SoftCraft Presenter attempt to blend the traditional creation metaphor with a judicious application of sound and video, but the results are compromised: They lack the ease of use and polished interfaces that characterize the current generation of presentation graphics packages, and they lack the synchronization tools required to create sophisticated multimedia presentations without demanding too much from the user. Action! forgoes the hard-copy route altogether, instead choosing to focus on multimedia integration, ultimately making it a better multimedia presentation product, but one that will appeal to a narrower group of users.

It will probably require a generation or two of interface refinement coupled with a higher audio and video comfort level before desktop presentations overtake hard copy–based ones. But we've got to start somewhere, and these products offer a fine entry into the world of multimedia.

Asymetrix Corp.

Compel

BY ROCK MILLER

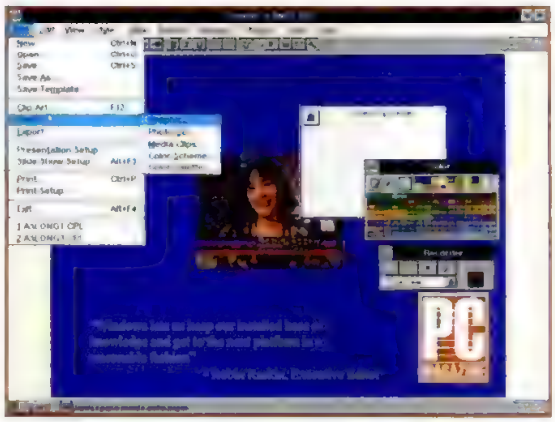
A latecomer to a crowded field, the $295 Compel, Version 1.0, from Asymetrix Corp., applies a new twist to an old formula, adding a few simple but carefully selected multimedia capabilities to the familiar, slide-based presentation metaphor. Although the results are far from perfect in this early release, you'll find that Compel does a good job of juicing up your screen shows with Microsoft Windows multimedia effects without requiring you to go to film school.

SUITABILITY TO TASK

Compel 1.0

	POOR	FAIR	GOOD	EXCELLENT
Simple multimedia presentation	●	●	●	○
Complex multimedia presentation	●	●	○	○
Printed output	●	●	●	○
Electronic delivery/ portable output	●	●	●	○

At first glance, Compel presents itself as an orthodox presentation program, with templates, slide and title sorters, automated word charting, speaker's notes, and other features common to such packages. Although Compel conspicuously lacks a text outliner, it does allow you to mix and match different 16-color schemes with a good range of templates, most of which are attractive. An adequate if utilitarian selection of clip art is included, and you can import a wide range of graphics file formats. Compel's basic set of drawing and editing tools also works reasonably well.



Compel's basic multimedia tools allow you to embed video, animation, and sounds directly into your slides.

What Compel lacks, however, is the polish that its competitors have gained through multiple development cycles. Compel's interface is generally easy to figure out and navigate, but it also has a number of noticeable rough edges, including an unwillingness to apply changes to multiple objects (though it claims to have this capability), an eyedropper tool that cuts and pastes colors and lines but not text attributes, and a template system that is easy to override but hard to reapply if you change your mind.

The program's attractiveness is also dimmed by its sluggish performance. Redraws were fairly efficient, but on our 33-MHz 486 test system the program still generated enough slow transitions and random pauses to be bothersome. Its automatic slide transitions were 2 seconds apart in our tests. Finally, incompatibilities with our Diamond Stealth Pro 256-color drivers were a source of frustration. Clearly, Asymetrix needs to work on Compel.

MULTIMEDIA MADE SIMPLE

Compel's well-implemented multimedia support, however, compensates for these faults of execution. It wisely doesn't try to compete with full-blown multimedia authoring systems, and you won't find time-line synchronization, path animation, or object fades in its list of tools. Instead, it offers a few eye-catching but easy-to-use effects that you can add, with little effort, to otherwise ordinary presentations.

Boring word charts, for example, can be jazzed up considerably by "flying in" the separate points as you speak, a feat that Compel accomplishes using a single dialog box. Compel's equally basic start-stop animation feature makes it easy to generate moving arrows and other graphic points of emphasis, or to create an appearance of growth or shrinkage, although we found this procedure to be rather awkward and time-consuming.

Multimedia events (Compel supports all MCI-compatible devices and their corresponding multimedia events) are

FACT FILE

Compel, Version 1.0
Asymetrix Corp., 110 110th Ave. NE, #700, Bellevue, WA 98004; 800-448-6543, 206-462-0501; fax, 206-455-3071

List price: $295.
Requires: 386-based PC or better, 2MB RAM (4MB recommended), 4MB hard disk space (14.5MB recommended), DOS 3.1 or later, VGA display or better (256-color VGA display or better recommended), Microsoft Windows 3.1.
In short: Despite sluggish performance and a few rough edges, Compel is a good tool for those who want to create simple slide-based multimedia presentations. This represents a step in the right direction for making multimedia accessible to time-pressed business presenters. Look for the next version to smooth out those first-release quirks.
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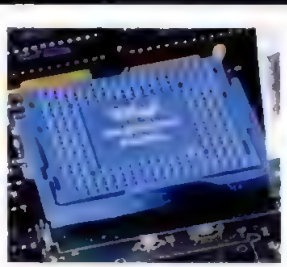

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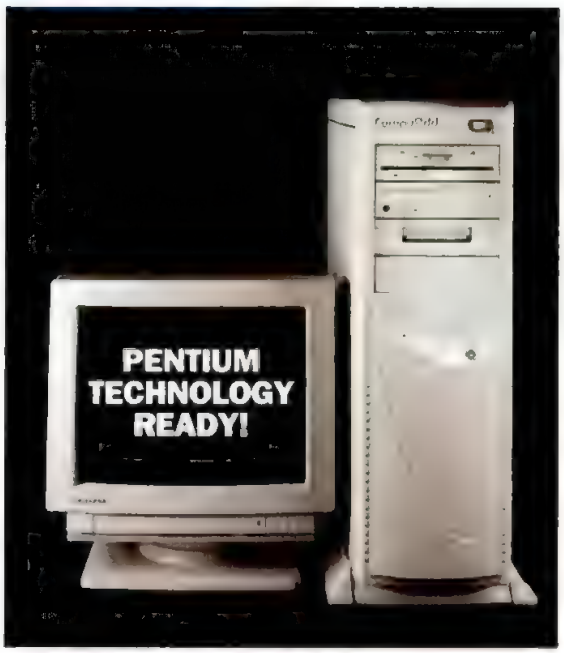

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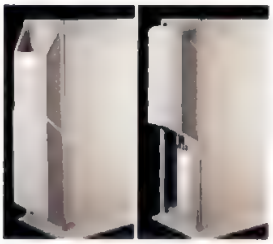

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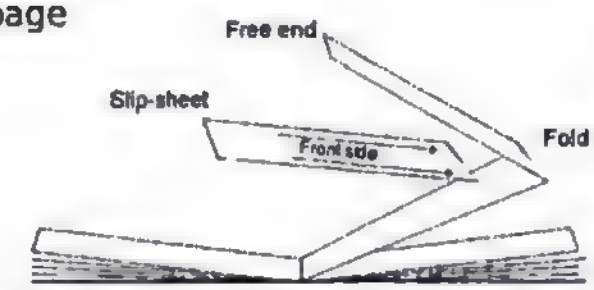
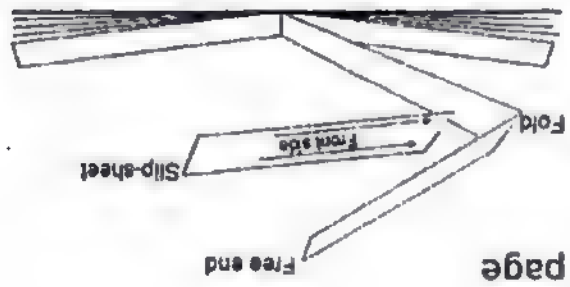


Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



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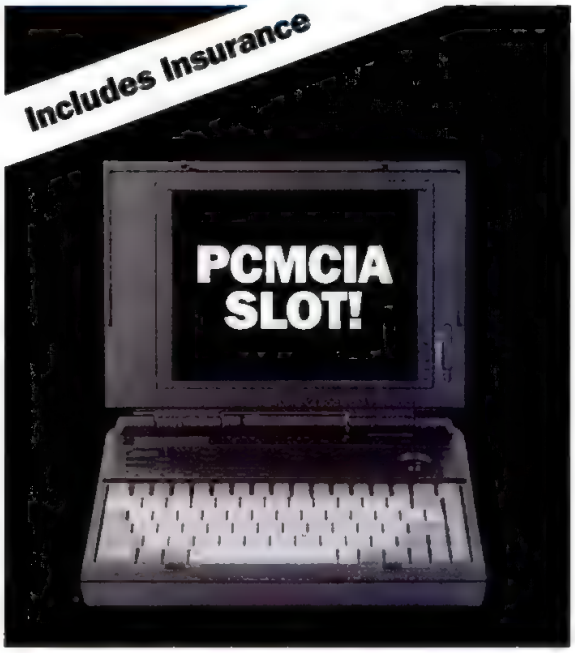

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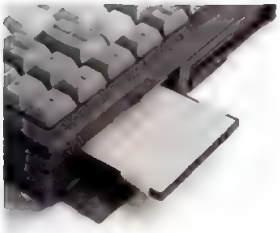

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▶ SUMMARY OF FEATURES CONTINUES

Desktop Presentations

PC MAGAZINE EDITORS' CHOICE

Products listed in alphabetical order

■ = YES □ = NO

	Compel	Macromedia Action!	SoftCraft Presenter
List price	$295	$495	$595
Operating environment	Windows	Windows	Windows
Maximum number of colors displayed	16.8 million	256	16.8 million
DDE and OLE support	OLE 1.0	DDE (charting only)	DDE, OLE 1.0
Charting			
Text/data import:			
Imports standard text formats*	ASCII only	ASCII only	.RTF and .TXT only
.CHT	□	■	□
.DBF	□	■	■
Lotus 1-2-3 chart	□	■	□
.WK*	□	■	■
.XLC	□	■	□
.XLS	□	■	■
Chart creation:			
User can create bullet charts	Automatically	Manually	Automatically
Can create data-driven charts	■	■	■
Can create 3-D charts	■	■	■
Number of chart types	10	4	10
Chart editing and formatting:			
User can edit text directly on chart	□	■ (except data charts)	■
Can scale chart to fit	■	■	■
Maximum number of colors per chart	16.8 million	256	16.8 million
Sound Integration			
Devices:			
Ad Lib	■	■	■
CD-audio	■	■	■
PC speaker	□	■	■
Sound Blaster	■	■	■
Other	Any Windows MCI device	Any Windows MCI device	Any Windows MCI device
Importable file formats:			
MIDI	■	■	■
.WAV	■	■	■
16-bit/stereo sound output	■■	■■	■■
Sound manipulation:			
Records/duplicates sound	■■	□■	■■
Fades out/Loops	□■	□■	■□
Plays multiple sounds simultaneously	■	■	■
Plays when triggered by user	■	■	■
Synchronizes with video	□	■	□
Video Integration			
Device support:			
Video capture boards/Software	Any Windows-supported device	None	None
Videodisk (CAV/CLV)	Any Windows MCI device	None	Any Windows MCI device
Importable file formats	.AVI, any MCI-compatible format	.AVI, .DVI (with card), Indeo, .MOV	.AVI, any MCI-compatible format
Video manipulation:			
Can edit video clips	□	■	□
Can crop video to viewer	■	■	■
Can loop	■	□	■

* Standard text formats are ASCII, .RTF, Microsoft Word for Windows, and WordPerfect formats

triggered by means of "media links" that can be attached to any object or to the slide as a whole. You can trigger events using the movement of individual bullet points or animated objects, or you can activate events manually by clicking on objects. Any object, including text "hotwords," can also be set to activate a hyperlink jump to another slide or an OLE link to another Windows application. The timing and speed controls of these items are minimal but easy to apply.

Linking and tracking your various media files is quite simple. You can add clips as resources, cut them to length, and loop or repeat them using a single dialog box. Handy packaging and compression tools make it easy to compile these resources into one place for transporting into another system.

Compel lets you trigger events using individual bullet points or animated objects, or activate events manually by clicking on objects.

Compel supports the OLE 1.0 client specification, and includes a runtime of Microsoft Video for Windows in the package. The capacious CD-ROM on which it is distributed (it also comes on disk) contains a large collection of sample clips.

Compel's only major omission is its inability to animate data charts in even the simplest fashion. Indeed, its charting module (a separate applet linked via OLE, as with Microsoft PowerPoint) is the feeblest part of the package, giving you little control over anything except colors and patterns of data series. Although you can select the font style for various elements, the sizes of the text labels and the locations of elements such as legends are predetermined and inflexible (we could not shade or hide the title text in our data sheet). The data sheet can't import even such standard formats as .XLS or .WK1, and it doesn't support

SUMMARY OF FEATURES CONTINUES

Products listed in alphabetical order

■ = YES □ = NO

	Compel	Macromedia Action! (PC MAGAZINE EDITORS' CHOICE)	SoftCraft Presenter
Animation Integration			
Importable file formats:			
.AVI/.FLC	■■	■■	■■
.FLI/.MMM	■■	■■	■■
Animation manipulation:			
Can create animation	■	■	■
Can edit animation	□	■	■
Can loop	■	■	■
Can crop	■	□	■
First or last frame remains visible after animation plays	□	■	■
Clip Media			
Imports standard graphics formats**	All	.BMP/.DIB, .WMF	All
Number and format of clip art images supplied	350 (proprietary)	8 (.DIB)	69 (proprietary)
Number and format of sound clips supplied	200 (MIDI, .WAV)	6 (.WAV)	None
Motion clips:			
Number and format of animation clips supplied	30 (.FLI)	20 (.MMM)	18 (.DPC)
Number and format of video clips supplied	25 (.AVI)	None	None
Text Handling			
Can add special effects to text	■	■	■
Automatically creates progressive builds	■	□	■
Can adjust kerning and leading	□	□	■
Can align text on baseline	□	□	■
Can rotate text	□	□	■
Illustration/Image Manipulation			
Number of illustration tools	10	6	12
Image manipulation tools:			
Can align to baseline/to object	□■	□■	■■
Can group objects/break objects apart	■■	□■	■■
Can resize objects	■	■	■
Presentation Management			
Offers multiple backgrounds per presentation	■	■	■
Can suppress background for individual slide	□	■	■
Templates:			
Offers user-definable slide templates	■	■	■
Allows multiple templates per presentation	■	■	■
Number of predefined templates	100	146	26
Number of multimedia templates	100	13	None
Presentation organization:			
Title sorter/Slide sorter	■■	□■	■■
Outliner	□	□	■
Speakers' notes	■	□	■
On-screen Presentations			
Can add special effects to charts	□	■	■
Number of special effects	None	56	25
Hyperlinks to other slides/applications	■■	■□	■■
Can launch events at user command	■	■	■
Number of transition effects	43	46	13
Offers multiple transitions per presentation/slide	■□	■■	■■
Provides on-screen annotation tool	□	□	■
Can overlay images	□	■	■

** Standard graphics formats are .BMP/.DIB, .CGM, .PCD, .PCX, .TIFF, and .WMF

DDE links to external spreadsheets, either. Those who use data charts extensively will want to link them in from other Windows packages.

Compel makes a good first attempt at tackling the problem of making multimedia accessible to time-pressed business presenters. Those looking to create the most stunning multimedia presentations won't be impressed. But, blemishes aside, if you want to add spice to your slide-based presentations, Compel is definitely worth a look.

Macromedia Inc.

Action!

BY LORI GRUNIN

Although creating content isn't one of Action!'s fortes, putting it together most certainly is. The excellent synchronization tools in Version 2.5 of Macromedia's $495 package allow you to meld sound, video, and animation seamlessly into professional-looking electronic presentations.

Unlike the other products in this story, which rely on the single-frame slide approach, Action! uses a timeline as its central organizing metaphor. Each object

SUITABILITY TO TASK

Macromedia Action! 2.5

	POOR	FAIR	GOOD	EXCELLENT
Simple multimedia presentation	●	●	●	○
Complex multimedia presentation	●	●	●	●
Printed output	●	○	○	○
Electronic delivery/ portable output	●	●	●	○

in an Action! scene, including traditional elements such as color and size, has three time attributes: Enter, Hold, and Exit durations. Changing durations can be as interactive as dragging segments in Action!'s Timeline or as precise as entering values as small as a tenth of a second.

You can also control the flow of a presentation, either automatically—by predefining the next scene to which you jump—or via easily created user-definable buttons.

In contrast to the Timeline, which shows only individual scenes, a Scene Sorter gives you an overview of the presentation, complete with scene-to-scene

The Tandy Sensation Can Recite The Speeches Of JFK.

It can let you hear the words "ask not what your country can do for you," as only JFK could speak them. And tell you just how those words travel through your ears to your brain with a vivid animation sequence. It can read back to you over the phone the time and place of your business meetings for the week. And pronounce for your child a word she couldn't say herself. It can play an aria from *Madame Butterfly* in full digital stereo sound. And give you the final word on how the stock exchange did for the day. It can even answer your phone and take a message when your mother-in-law calls from Miami. But perhaps what says the most about the Tandy Sensation isn't what it can say, but what it can make others say. Reviewers at such respected computer journals as *BYTE* Magazine, *Compute* and *PCM*, for example. Because in the past few months, the Sensation, with its CD-ROM drive and 486SX microprocessor, has received glowing reviews from each one of these magazines for its power, versatility and usefulness. And the good word keeps spreading. Which speaks volumes, of course, for why you should stop by your neighborhood Radio Shack to see and hear a Tandy Sensation for yourself.

> Overall kudos go to Tandy's Sensation; it's a well thought out execution of what every MPC (multimedia personal computer) system manufacturer should strive to emulate.
>
> *-Greg Loveria*
> *-BYTE Magazine*
> *May 1993*

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CIRCLE 289 ON READER SERVICE CARD

SUMMARY OF FEATURES — ENDS

Products listed in alphabetical order

■ = YES □ = NO

	Compel	Macromedia Action! (PC MAGAZINE EDITORS' CHOICE)	SoftCraft Presenter
On-screen Presentations (continued)			
Runtime module:			
Operating environment	Windows	Windows	Windows
Interactive/automatic operation	■■	■■	■□
Automatically incorporates all necessary files	■	□	■
Includes pointers to all necessary files	■	■	■
Output			
To slide/overhead	■■	□□	■■
To laserdisk/videotape	■■	■■	□■
To printer	■	■	■
Print options:			
Prints preview	□	□	■
Prints handouts	■	□	■
Prints speakers' notes	■	□	■
Can suppress slide background/gradients	■■	■■	■■
Converts colors to gray scale	■	■	■
Converts colors to pattern fills	□	□	■
Maximum number of slides per page	16	4	28
Documentation and Support			
Tutorial	On-line	Video	Paper
Free technical support hours (eastern time)	9:00–9:00, M–F	10:00–7:00, M–F	9:30–6:30, M–F
BBS	America On-line, CIS, proprietary	CIS	CIS

transitions and flow logic, and a Content List displays all the elements of the presentation organized by scene.

In addition to the canned transition effects, Action! lets you create simple point-to-point and path-based animations simply by dragging objects to their new locations and defining a time interval for how long the animation should play.

Action!'s Timeline controls synchronization among elements within individual scenes in a presentation.

Action! can also automatically animate data charts so that, for example, your bars can grow or your pie wedges can fly onto the screen. The product allows you to create these charts within the package, and its data sheet is one of the more intelligent we've seen: Instead of requiring that you put data and labels in specific places, the program allows you simply to highlight a range and define it.

Unfortunately, Action!'s charting has one major problem—you can't define the axis scales for bar charts, which don't start at 0,0 (unless you have a data point there). Thus, if your lowest data point happens to coincide with the lowest tick mark, your bar disappears. If you need to bring in a chart (or any other object) from another package, you can use Action!'s neat Explode Metafile option to animate the components.

TEMPLATES WITH A TWIST

Like traditional presentation products, Action! uses templates for consistent global background objects and element attributes; unlike the older products, however, Action!'s background objects are animated. The product comes with 12 template families, each containing a variety of chart types. But selecting a template requires a few more steps than is really necessary. The hard-copy Template Guide is black and white, so to see the colors you need to use the preview option, located in the Load Template dialog box.

Sticking with the supplied templates and analyzing their timelines is the best way to learn the package (it ships with a videotape that gives a quick overview of the product, but no tutorial), but novices may still take a long time to get up and running, and advanced users may be hindered by some trivial annoyances in the program. For instance, in order to automatically stagger scene objects relative to template objects, you have to promote the template objects to a scene. And although you can select whether or not to copy the time attributes of an object while cutting and pasting, Action! lacks any way to copy time attributes across disparate objects.

Users who need to create text-intensive charts may also become frustrated by the lack of automatic bullet-charting capabilities, and the lack of a direct text-

PC MAGAZINE EDITORS' CHOICE — FACT FILE

Action!, Version 2.5

Macromedia Inc., 600 Townsend St., San Francisco, CA 94103; 800-288-4797, 415-252-2000; fax, 415-626-0554

List price: $495

Requires: 286-based PC or better, 2MB RAM (4MB recommended), 10MB hard disk space (15MB recommended), DOS 3.1 or later, Microsoft Windows 3.x, VGA display

In short: For producing business presentations incorporating sound, video, and animation, Action! is currently without peer on the PC. Its Timeline and Scene Sorter tools make synchronizing elements a breeze. The product's tools for creating more traditional text-intensive or hard copy–based presentations, however, are more limited, and its printing capabilities are sorely lacking. This may not be the easiest package to learn, but it's well worth the effort.

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Video	14" VGA; 640x480	14" VGA; 640x480
Floppy	One	One
MS-DOS, Windows 3.1 and mouse	Yes	Yes
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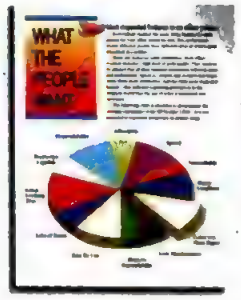

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import capability. You can, however, work around these shortcomings by using bullet-chart templates and by pasting text in through the Windows Clipboard.

The Windows-based Action Player can display any native Action! file as long as it doesn't contain a chart. If it does, you must save it as a Player file. While the native files and the Player files tend to be on the large side, they're still smaller than the competition's. Action! externally references .AVI files, and our 12-scene multimedia presentation, which had a few small embedded bitmaps, was over 4MB.

You can print hard copies of the scene view, content list, animation, or Timeline. Though the program had no problems printing scenes to our color PostScript printer, its translations to monochrome (both PostScript and PCL) were bad. The program offers an option to print without the background, but Action! isn't intelligent enough to convert white text to black when the option is selected. On the other hand, Action! offers a handy Print to Video option—provided you have the appropriate VGA-to-NTSC hardware.

Despite some shortcomings, Action! is probably the most powerful of its competitors for creating multimedia-intensive presentations. Action! falls short in hard-copy output, but for electronic output, it's hard to beat.

How We Tested

To evaluate these packages, we looked at their ability to create a simple presentation, which could be completed in 4 hours or less, and a complex multimedia presentation, for which we allowed up to three days to complete. Both of these presentations included multimedia elements such as animations, sound clips, and video clips. The goal was to create attractive presentations representative of what the average business user could create and deliver using average equipment.

First, we tested a product's ability to create a five-slide presentation, paying special attention to how quickly a first-time or infrequent user could get up to speed. We looked at the quality of each package's masters, tutorials, on-line help, and ease of use in handling templates, clip art, and clip media. This presentation consisted of a title slide, a data chart using imported data, an animated bullet chart, a free-form text chart with clip art and animation, and an annotated illustration with an attached multimedia event.

Next, we tested the packages' usefulness for creating a full-fledged multimedia desktop presentation, focusing more on creative control than ease of use. We tested each system for its control over multimedia elements and special effects, the power of its OLE support, and its charting options for both text and data charts. This presentation consisted of 15 multimedia-intensive slides that included imported .AVI, MIDI, and .WAV files playing simultaneously, and animated text effects generated by the package. The most complex of these slides called for the reviewers to import an animated PC Magazine Labs logo, which played at the same time as a MIDI sound clip. After the FLC animation finished running, we required the final frame to stay on the screen until the end of the sound clip. Next, six scanned TIFF files of *PC Magazine* covers appeared on the screen.

SoftCraft Inc.

SoftCraft Presenter

BY STEPHEN W. PLAIN

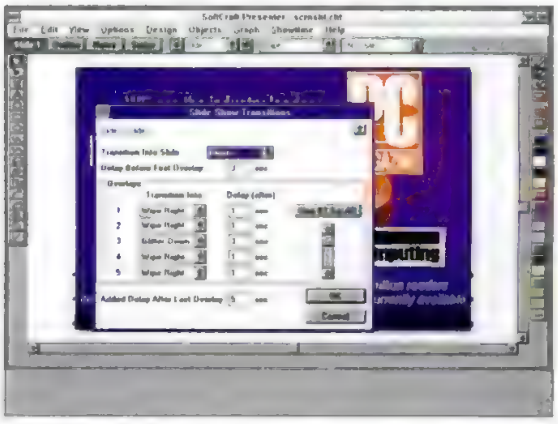
Offering more power than glitz, SoftCraft Presenter, Version 2.0, is suitable for creating serious multimedia presentations. This $595 Microsoft Windows–based package offers tools that will appeal to the casual user as well but in comparison with the other packages will present those users with a steeper learning curve to overcome.

Presenter's environment is that of a traditional presentation package. It offers four basic modes—slide, outline, notes, and sorter. Speaker's notes are created in notes mode, and sorter mode lets you work with thumbnail versions of all of the slides in the presentation. These views are always accessible through interactive toolbar buttons. Presenter has full 24-bit color support to provide a selection of up to 16.8 million colors, 16 of which are made available at any given time in an on-screen color palette.

Presenter offers some powerful tools for ambitious users. Every object you place on a slide can be assigned to an ordered overlay, which can be tuned with its own transition effect and timed relative to the previous overlay. With a little work, you can create fairly complex slides. During testing, we were able to build a single slide with an animated pie chart, voice-overs, a soundtrack, and then precisely timed sound and image combination events.

Such multimedia flexibility makes Presenter seem naked without a time-line feature, like Action!'s, that would let you fully exploit Presenter's capabilities. Instead, you must enter values in a dialog box to determine the timing in seconds of each overlay, and each overlay is only referred to by its number.

Other powerful features include a subselect command, which allows you to drill down into a complex image such as a pie chart and select a particular caption or data series, and the use of the pasteboard—the white space between the edges of your slide and the border of the Presenter application window—to store



SoftCraft Presenter allows you to assign transition effects and timing to each object independently.

3 seconds apart, with each graphic accompanied by a short .WAV format sound effect. Once all the elements were on the screen, a 15-second .WAV voice clip played to give an overview of the presentation.

To evaluate the quality of each package's hard-copy and printed output, we printed the finished presentations on an HP LaserJet III, an HP DeskJet 500C, and a Tektronix Phaser IIPXi color PostScript printer. We looked at not only the overall appearance, but the flexibility of the printing options for generating handouts and speaker's notes. We tested each system for capabilities such as customizing printouts, intelligently converting colors to shades of gray, and providing place holders for multimedia objects.

Finally, we tested each package's ability to create a runtime version of a presentation and the flexibility of the package's on-screen presentations. We looked at whether each package automatically includes all the necessary multimedia files in the runtime, how much control the user has over playing the finished presentation, and the overall quality of the display and sound.

Our test-bed consisted of Compaq Deskpro 486/33M EISA systems, each equipped with a 310MB hard disk and 8MB of RAM, a Diamond Stealth Pro ISA Windows accelerator card with 2MB RAM running at 800-by-600 resolution with 256 colors, an NEC MultiSync 4FG monitor, and a MediaVision Fusion CD 16E MultiMedia upgrade kit. We used the Turtle Beach MultiSound audio board, Prosonus's MusicBytes, Lenel Systems International's Multimedia Works, the HP ScanJet IIc, and Autodesk Animator Pro to create our test files.

If you would like to download a sample portion of the presentations we created while testing, you may do so from the *PC Magazine* Editorial Forum located on ZiffNet. Type: GO ZNT: EDITOR from any CompuServe or ZiffNet prompt, and you'll find the sample files in Library 3, Features-Software. Search on the keyword "CLIPS."

objects temporarily. The package also gives you the ability to create simple animations between two objects. Presenter will build an animation between a start and end object of the same style, and even transform the color, size, and shape along the way. Through a bidirectional DDE link with applications such as Microsoft Excel, you can have your presentation issue incrementing values to the external program and, based on another DDE link to the spreadsheet, have your chart values grow accordingly.

The major addition to this version of Presenter is the interactive SCPlayer program. Presentations, even those containing animations and movies, can be exported into a single distributable runtime file for use with the player. Although the SCPlayer program only works with Windows 3.1, Presenter also includes Autodesk's AAWIN player, which will also work with Windows 3.0. Presenter's runtime export dialog allows you to choose between the two runtime formats.

SUITABILITY TO TASK

Softcraft Presenter 2.0

	POOR	FAIR	GOOD	EXCELLENT
Simple multimedia presentation	●	●	●	○
Complex multimedia presentation	●	●	●	○
Printed output	●	●	●	○
Electronic delivery/ portable output	●	●	●	○

MULTIMEDIA MADE SIMPLE

If you're snapping together quick or infrequent presentations, you'll find yourself torn between the consistent performance and flexibility of Presenter and its frustrating documentation and scattered menus. In testing, we were able to attach MIDI, .WAV, and CD-audio tracks quickly to various objects without performance problems. Presenter's use of datapictures, in an intelligent clip-art format, makes animating graphs a snap. The provided datapictures contain animation frameworks such as growing bar graphs with shadows and a template for "flying" text in from an angle. Presenter also allows you to record voice annotations directly into the program as you're building slides.

Presenter's menus, however, are organized inefficiently, and will occasionally send you scrambling through the reference manual for the right command. The transition effects for an object, for example, are not accessible through the Object menu but rather through the Showtime menu, the place to turn when you want to modify the transitions for slides.

When creating bullet charts, it's best to switch to the outliner view, where creating multiple build screens is an extremely intuitive process. You can import ASCII, Microsoft Word, and .RTF files into the outliner to create bullet charts automatically, then print them using Presenter's superior hard-copy output.

During testing, we printed our presentation on a color PostScript printer and produced flawless output. Drivers and communication software are also included for using the Autographix Slide Service to produce 35-mm slides.

SoftCraft Presenter is certainly well suited to developing multimedia presentations and presents very few obstacles to meeting your design goals. Although its interface isn't the prettiest, Presenter provides the tools you need to produce first-rate presentations.

FACT FILE

SoftCraft Presenter, Version 2.0

SoftCraft Inc., 16 N. Carroll St., Madison, WI 53703; 800-351-0500, 608-257-3300; fax, 608-257-6733

List price: $595.

Requires: 286-based PC or better, 2MB RAM (4MB recommended), 4MB hard disk space (6MB recommended), CGA display (VGA display or better recommended), DOS 3.0 or later, Microsoft Windows 3.x.

In short: What SoftCraft Presenter lacks in glamour it makes up for in power. Overall, it presents all the tools you need to create powerful multimedia presentations, but it may force you to jump through hoops to learn how to use them. The one real omission from this stellar performer is a timeline for synchronizing media clips; without one, it's almost impossible to get playback timed properly.

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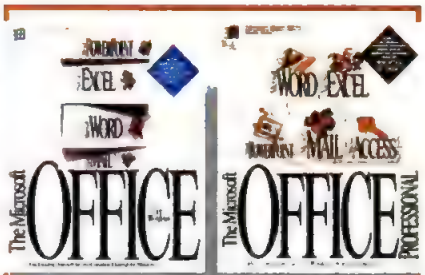

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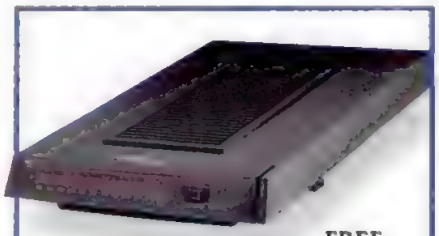

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Tips for a Better Presentation

COMPILED BY JOHN MOORE The adage "discretion is the better part of valor" is especially valid if you're using multimedia in a desktop presentation. Sound, video, and animation can add life to your presentation, or if used improperly, can make a mess of your message. We have compiled some tips from desktop presentation software manufacturers on how to use multimedia effectively in a presentation.

▶ **GO WITH A SPECIALIST.** Use a specialty product such as an animation, paint, or sound package to create each of your multimedia elements. Avoid the temptation to cut costs by trying to use one package for everything.

▶ **ROLL YOUR OWN.** Ensure consistency in your company's presentations by creating your own media clip library. Include things like your company logo, corporate music, and relevant graphics, especially background templates.

▶ **TIMING IS EVERYTHING.** Use audio and video within slides—do not use these elements as a cue to change slides or topics within your presentation. You'll be hard-pressed to match your verbal presentation to the timing of any cues.

▶ **SIMULATE ACTION.** Use sound to make the audience feel there's action, even when there's nothing on-screen. This is especially helpful when you're waiting for something to happen, such as a high-resolution image that takes a while to load.

▶ **TAKE CONTROL.** Audio is used most effectively in presentations you will be distributing on disk or videotape for the obvious reason that you won't be there to deliver your message in person. Conversely, sound should be used sparingly in presentations you will be making in person.

▶ **DOUBLE THE SOUND.** Include both a music (MIDI) and voice clip in your presentation. This is especially effective when creating a runtime version of your presentation to send to clients. They can see your presentation and hear your voice annotations during the slide presentation.

▶ **SMALLER IS BETTER.** If you want to synchronize voice files with your presentation, use several small files. Attempting to synchronize one large file with several slides is very difficult and depends on the speed of your computer. It is also easier to fix mistakes in a small voice file because you don't have to rerecord everything just to fix one mistake.

▶ **BRING IT TO LIFE.** The best use of animation is to make your company logo or product mark come to life. Avoid the tendency to be too cute with animation.

▶ **MAKE IT REAL.** Use animation and video to convey complex or abstract concepts, such as how DNA molecules are constructed. Animation in particular is great for helping an audience visualize how a theoretical piece of equipment works, while video is helpful for demonstrating a product that is already in use.

▶ **MAKE IT MATCH.** Make your animations fit your presentation by working with the same color schemes, fonts, and backgrounds. Use one attractive design with variations for different presentation components such as titles, word charts, and graphs.

▶ **QUALITY COUNTS.** Avoid low-quality clip art and avoid mixing clip art of different qualities within a presentation. If you're using 3-D graphs with 256 colors, introducing a 2-D, 16-color piece of clip art will make the whole presentation look shoddy.

▶ **ONE AT A TIME.** Be sure that animated objects move into place one at a time. If too much is happening at once, the audience doesn't know where to focus.

▶ **DON'T DISTRACT.** Don't use dramatically different special effects on the same types of objects. It's distracting if each line of bulleted text enters the screen in a different manner.

▶ **SPICE IT UP.** Video is an effective way to present dry information. It can be more effective to run a video clip of a person talking than simply to repeat his or her message in a text chart.

▶ **KEEP IT SIMPLE.** Gratuitous use of anything, particularly animation, will work against your communication goals. Keep it simple—audio and video should be used in moderation to support your message, not overwhelm it.

▶ **KEEP IT LEGAL.** Watch out for copyrighted material. If your presentation is for any commercial purpose, you may need to contact ASCAP, BMI, or another copyright-protection organization for information on how to use commercial music in your presentation legally. The same warnings apply to video clips and scanned photographs. □

Old Favorites, New Tricks

If you're devoted to your traditional presentation package but want to dip your toes into the multimedia pool, these products can get you started.

by Lori Grunin

If you're not quite ready to scrap your tried-and-trusted presentation program for the thrill of living on the edge, never fear. You're not alone. But now that the major vendors of presentation graphics products are taking steps—albeit tentative ones—toward supporting multimedia, learning how to use sound, animations, or video clips in your presentations doesn't necessarily mean that you'll have to change software.

Out of the plethora of presentation graphics products currently on the market, only three—Lotus's Freelance Graphics for Windows, Release 2.0, Microsoft PowerPoint, Version 3.0, and Software Publishing Corp.'s Harvard Graphics for Windows, Version 1.03—purport to let you use sound, video, or animation in your electronic presentations.

Not surprisingly, these are also the market-leading packages. When it comes to generating attractive presentations quickly and easily, they are unsurpassed. For these reasons, Freelance and PowerPoint earned our Editors' Choice the last time we looked at traditional presentation graphics products (see "Presentations with Style, Substance, and Splash" in the November 10, 1992, issue of *PC Magazine*). What we haven't examined in the past are these products' capabilities for handling today's multimedia demands; we undertake that task here.

Don't let the fact that we cover only three products in this story fool you—presentation graphics software is alive and well and living in corporate America. In 1992, Microsoft Windows–based presentation products finally overtook DOS products. According to the Software Publishers Association, DOS products outsold Windows products in 1991 by three to one (dollar volume). In 1992, Windows products outsold DOS-based ones by three to two. Thus, announcements such as Lotus's decision to stop upgrading Freelance Graphics for DOS come as no surprise (although WordPerfect did ship the first version of its DOS-based WordPerfect Presentations last year).

We're expecting to see a raft of significant upgrades to major products in the third quarter of this year. Products currently in beta testing include new versions of Aldus Persuasion and Harvard Graphics for Windows, as well as a new product, WordPerfect Presentations for Windows (see the sidebar "Coming Soon to a PC Near You"). In addition, Micrografx will finally release a completely overhauled version of Charisma, and if Microsoft keeps to its 18-month release cycle, we'll see a new version of PowerPoint toward the end of the year as well.

PRIORITY ONE

Unlike the three desktop presentation packages reviewed in this issue, presentation graphics products have had the time to continuously refine their interfaces; in fact, all these vendors rank usability as their top development priority. Here, more than in any other product category, vendors are constantly searching for ways to let their users crank out presentations more quickly and efficiently. Given the current state of PC-based multimedia, it's clear why this goal can conflict with increased support of sound, video, and animation.

For these products, it's crucial to distinguish between electronic and multimedia presentations. All of the products in this story—and most of the products on the market—produce electronic slide shows and do it well.

But vendors in this market have adopted a wait-and-see attitude toward multimedia support, contending that their users have yet to find the problem that multimedia solves. The poor quality of the implementations in these products reflects this halfhearted commitment. Freelance Graphics and PowerPoint both use OLE for embedding multimedia objects, which offers you little control over placement and synchronization of the elements. Harvard Graphics for Windows doesn't even allow that much: To use sound and video you must launch media players as external applications.

On the other hand, this cautious attitude seems justified. According to a variety of industry sources, only about ten percent of presenters use electronic slide shows (some put this figure as low as seven percent, others as high as 25 percent), and of those, only about ten percent use sound and video. These figures may in part reflect the frustration of using multimedia with ill-equipped products, but they also reflect the mores of corporate bureaucracy. For instance, some companies are afraid their customers will perceive a fancy electronic pitch as a sign of the spendthrift 1980s, when the impression they want to give is that of the lean-and-mean 1990s. As a result, desktop presentations and even color hard copies are discouraged; monochrome handouts flourish. More justifiably, the policymakers are worried that allowing their employees to use multimedia will decrease their productivity due to the fritter factor. Finally, having more elements means there's more that can go wrong at show time; when you're making your pitch or having a rushed status meeting, you need bulletproof output.

These attitudes notwithstanding, most vendors intend to enhance their products' multimedia capabilities, although the degree to which they'll do so is proportional to the amount of nagging they get from their users. But you can certainly expect to see better integration of sound, video, and animation and improved synchronization tools incorporated into your old favorites some time soon.

Lotus Development Corp.

Freelance Graphics for Windows

BY STEPHEN W. PLAIN

Lotus Development Corp.'s Freelance Graphics for Windows, one of the two packages that won our Editors' Choice the last time we reviewed presentation graphics packages, was always the product to choose if you needed to create a professional presentation quickly and easily. The $495 Release 2.0 makes this process even easier, and adds scores of new features to an already feature-rich package. Although one of these major additions is the incorporation of multimedia, stability problems indicate that the program isn't quite ready for the multimedia market.

FACT FILE

Freelance Graphics for Windows, Release 2.0
Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142; 800-343-5414, 617-577-8500; fax, 617-693-4551

List price: $495.
Requires: 286-based PC or better, 3MB RAM (4MB recommended), 9MB hard disk space (19MB recommended), DOS 3.1 or later, EGA display or better, Microsoft Windows 3.x.
In short: The multimedia support may not be quite ready for prime time, but for creating traditional business presentations, this one is hard to beat. Its user-friendly interface and SmartMaster approach will get the infrequent presenter up and running quickly, while its newly added OLE client/server support makes creating and using slide-based presentations easier and more flexible than ever.
456 ON READER SERVICE CARD

Freelance's interface is notably uncluttered and is one of the easiest to learn. It's an MDI (multiple document interface) environment, which means you can edit multiple presentations at the same time in separate windows. The package allows you to choose from more than 100 SmartIcons, which represent common operations, and use them to create custom toolbars. Along the bottom of each window are buttons that define page layout, navigate through the pages of the presentation, and hide or show the toolbars. One of the handiest buttons resides there as well: a color/monochrome toggle, which allows you to see what a color page would look like in black and white.

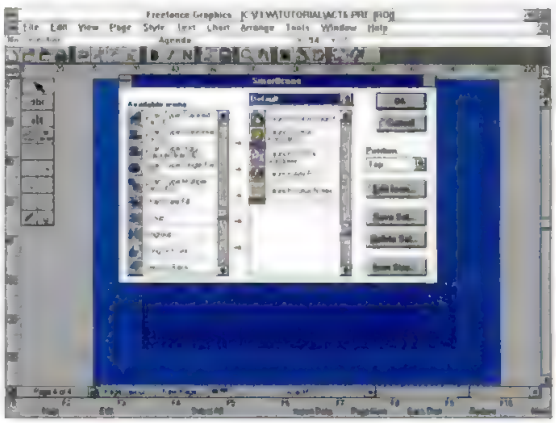
Freelance is especially well equipped for creating quick traditional presentations, thanks to the mélange of clip art (called symbols) and presentation templates (called SmartMaster page layouts) bundled with the program. These SmartMasters give you prebuilt page layouts comprising backgrounds and place holders for titles, charts, symbols, and tables that make it easy for even infrequent presenters to get up and running quickly.

NEW FLEXIBILITY

This version of the package solves the problem of the fixed predefined symbols found in Release 1.0 of Freelance by improving the SmartMasters to allow better placement of those symbols. Furthermore, the right mouse button is put to good use throughout the program; clicking it gives you a menu of formatting and editing choices specific to the object you have selected. If you select a toolbar icon, the program displays the action that the icon will perform.

Freelance presentations can now act as OLE clients and servers, meaning that in addition to embedding elements from other applications into your presentation, you can also embed the presentation into a document created in a Windows-based word processor such as Lotus's Ami Pro or Microsoft Word for Windows. Three companion programs—Lotus Annotator, Lotus Media Manager, and Lotus Sound—are included with Freelance.

You can use Media Manager to assign multimedia sounds or movies to Screen Show buttons that launch the element at runtime. You can also use Screen Show buttons to launch external Windows applications. Lotus Sound is similar to the Windows Sound Recorder and is used to create .WAV files and embed them into your presentation. Annotator allows you to attach nonprinting, nondisplaying personal notes to individual pages of a presentation.

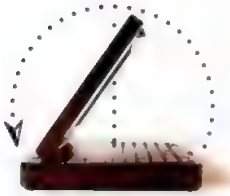


Freelance Graphics' SmartIcons allow you to choose from more than 100 icons to customize your toolbar.

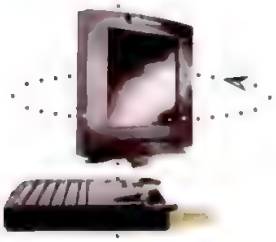
It sits, lies down, and does back flips.

Good b

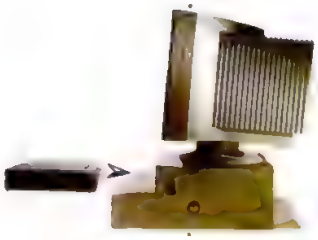
The most flexible screen ever seen



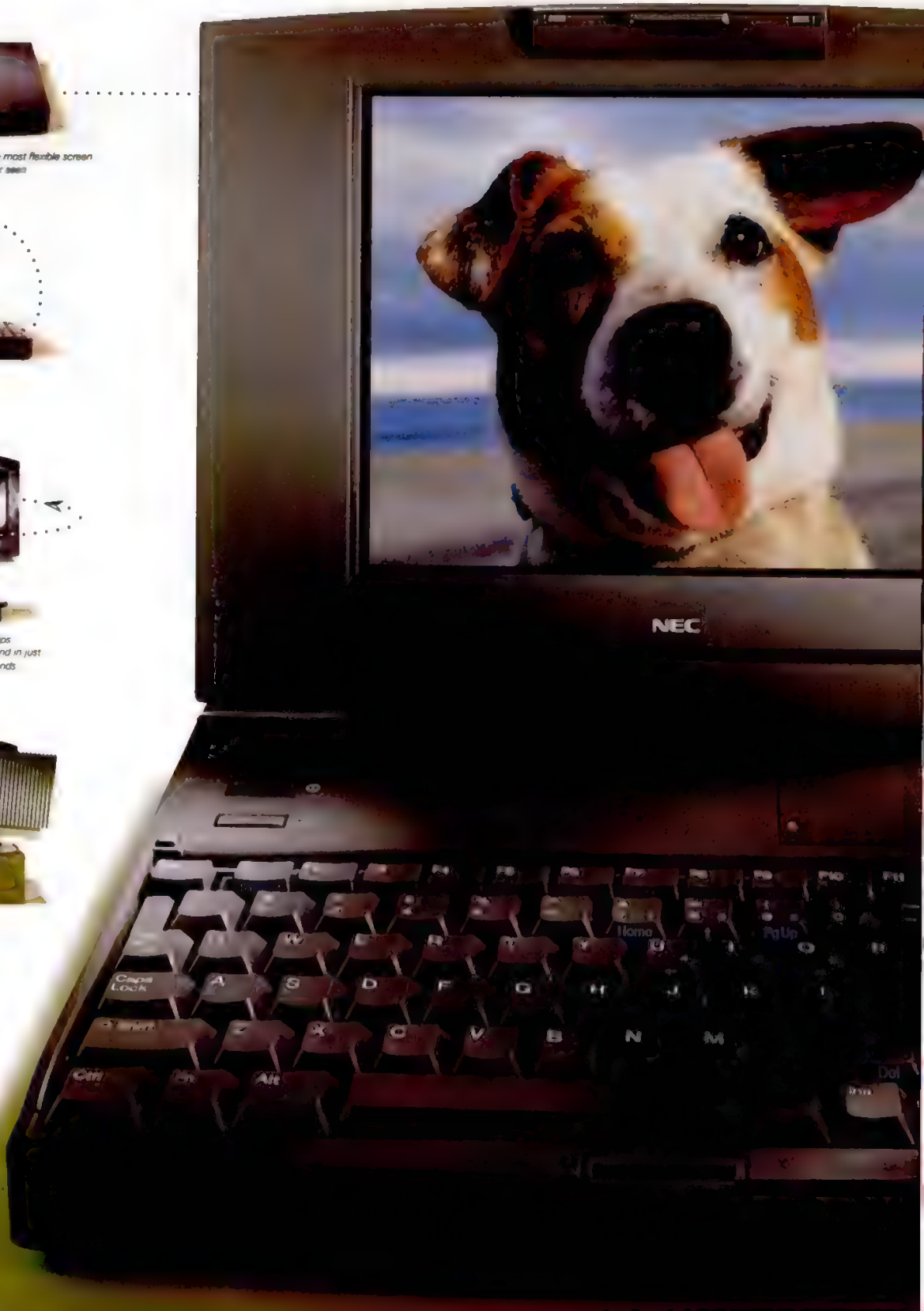
up to 180°



Or flips around in just seconds



There's even a Docking Station™ unit for full desktop computing



oy.

The UltraLite® Versa™ notebook gives new meaning to the term "faithful companion."

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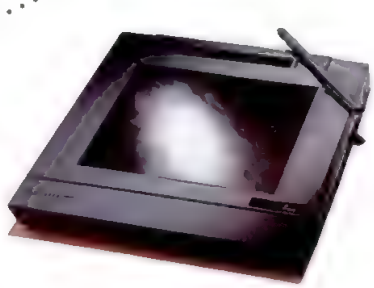
VersaPad



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Adding Media to Your Message

by Jeff Greenberg

While the latest generation of software is great for creating new multimedia presentations, it doesn't help people who can't upgrade or who have large libraries of existing nonmultimedia presentations. If you fit into one of these categories and want to add pizzazz to your monomedia presentation, you may be interested in one of the many OLE servers that let you add multimedia effects to any OLE client.

What, you may ask, is the difference between an OLE client and an OLE server? Think of an OLE server as a waiter: It picks up your multimedia tidbits from the kitchen (the application in which they were created) and delivers them to your table (your target application) via Object Linking and Embedding (OLE). An OLE client is the application waiting at the table for those tidbits to be served up.

The simplest way to add multimedia to an ordinary presentation (or document) is with the Microsoft Windows 3.1 Media Player, with which you can embed a multimedia object into any OLE client application. If you have Microsoft Video for Windows or Apple's QuickTime for Windows, you can even use the media player to embed movies into your presentation.

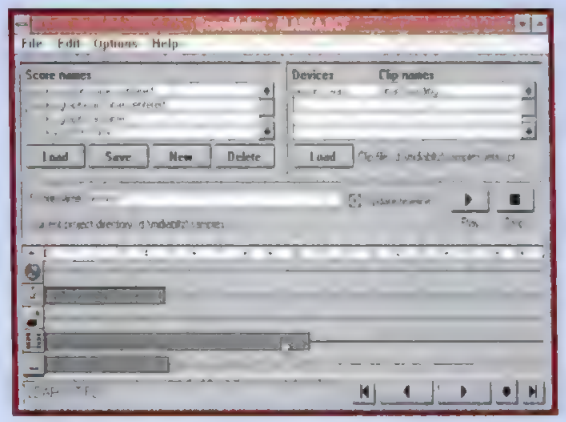
Although the Media Player is a good learning tool, you will quickly discover its limitations: Most notably, it can only play one media clip per slide. A number of companies offer advanced OLE servers that overcome this limitation. Following is a brief look at three such servers.

MultiMedia Works, Version 1.0 ($99; Lenel Systems International Inc., 716-248-9720), lets you quickly place a series of multimedia events into a list and then turn this list into one OLE object. You can incorporate still graphics, MIDI and .WAV audio, animation, and digital video into one multipart multimedia object. MultiMedia Works even lets you control analog devices such as a laserdisk.

In addition, MultiMedia Works lets you specify a background image and audio track to accompany your multimedia segment. Unfortunately, the software uses a sequence list as its organizing metaphor, which restricts you to displaying one image at a time.

KEEPING SCORE

Like Multimedia Works, MediaBlitz, Version 2.0 ($95; Asymetrix Corp., 800-448-6543), lets you combine a series of multimedia events into one OLE object. Unlike MultiMedia Works' list structure, however, MediaBlitz organizes the individual events according to a score. This score, which is essentially a time line, lets you see and modify the start time and duration of each individual multimedia clip, and allows you to overlap objects in terms of time and space. Using this approach, you can stack any number of events onto one another, such as overlaying bitmap images on top of videos or other bitmaps. In the mean time, you can play a sound track.



MediaBlitz, from Asymetrix Corp., uses a time line, or score, as its organizing metaphor.

MediaBlitz controls only those portions of the screen where it is displaying an image. Therefore, the slide from your presentation software remains visible on the rest of the screen, which means you can seamlessly move from your presentation software to the OLE server and back.

ANIMATION IMPACT

Instead of being a general-purpose multimedia server, Gold Disk's AddImpact, Version 1.0 ($149; Gold Disk Inc., 800-465-3375), focuses on animation. Like most animation packages, AddImpact is based on a frame metaphor, in which each frame is like a page in an animated cartoon or movie. An AddImpact movie contains a set of objects called actors. Each actor enters at a certain frame, moves across the screen according to a user-designated path, and then disappears. By combining actors with MIDI and .WAV sound, it's easy to communicate.

ON WITH THE SHOW...

As exciting as these capabilities sound, you should be aware of the caveats. First, these packages don't provide tools for creating the multimedia clips. Second, activating an OLE server can swamp most CPUs and disk systems—make sure your computer is fast enough to make the client-to-server transitions as smooth as possible. Finally, you should remember that accelerated graphics cards, video boards, sound adapters, and OLE servers are rapidly evolving technologies that don't always cooperate as nicely as we would like. You should always leave extra time to work out the kinks.

Despite these issues, multimedia add-ins can inject life and vitality into any presentation. These products can help you communicate more effectively and make sure that your audience stays focused and attentive. □

Although the new multimedia capabilities should allow you to add some nice bells and whistles to your presentations, you may encounter difficulties. During testing, we experienced several problems that seemed to be related to the incorporation of multiple multimedia elements. We encountered numerous general protection faults during the design phase of our complex presentation. The DOS runtime does not support multimedia objects. Lotus technical support could not replicate these problems.

In general, the Freelance presentation would play differently during successive runs. Sometimes the presentation, which incorporated .FLC animations, .AVI movies, and .WAV and MIDI files, would play well. But sometimes it would lose a sound, and at other times it would crash Windows. We had no problems at all, however, working with traditional presentations that did not include multimedia elements.

Also new is the inclusion of software to access the Autographix Slide Service. One long-standing printing problem, however, still remains in this improved version of Freelance—the dreaded "clipping" syndrome. Because Freelance defaults to a mode that allows you to create pages larger than the printable area, it's easy to complete a presentation only to have the edges of pages cut off when you print. Although there is an option to display a dashed line around the printing area on-screen, you must manually move all of your objects into this area to rectify the problem. For this reason, you should always activate this option before beginning to design your presentation.

Although the multimedia elements of the program are not totally reliable, Freelance Graphics for Windows continues to evolve as one of the simplest, most powerful tools for creating traditional business presentations. Because it sports one of the most user-friendly interfaces around, Freelance won't intimidate the novice presenter while making the task of composing your pitch a pleasure.

Software Publishing Corp.

Harvard Graphics for Windows

BY ROCK MILLER

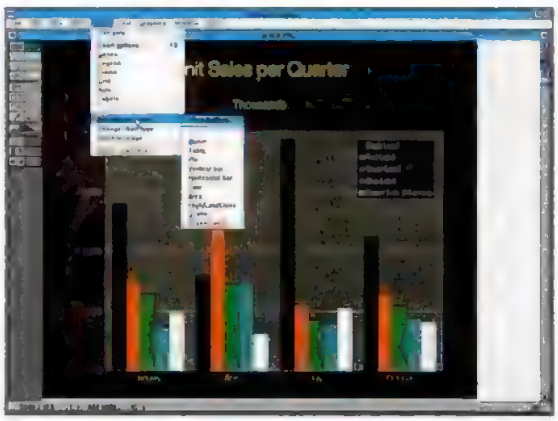
At the time of our review, Software Publishing Corp. (SPC) was preparing an updated version of its flagship Microsoft Windows–based product, one with significantly enhanced multimedia support, which should be available by the time you read this (see the sidebar, "Coming Soon to a PC Near You,"). In the meantime, users of the $595 Harvard Graphics for Windows, Version 1.03, will find their multimedia possibilities severely constrained compared with users of other mainstream presentation packages.

Unlike Freelance Graphics for Windows and Microsoft PowerPoint, Harvard Graphics for Windows does not support OLE (the next version, however, will offer OLE support), so it is impossible to embed sounds and other multimedia events for playback within your screen shows. Consequently, we were unable to perform the complex multimedia presentation portion of our test.

Freelance continues to evolve as one of the most powerful tools for creating traditional presentations.

Harvard Graphics did perform well in simple multimedia presentation—the type that infrequent presenters often need to complete within a tight deadline. We were able to create a five-slide presentation very quickly; Harvard Graphics provides quick, form-based text entry, and features attractive charting and a speedy screen show utility with hyperlinks.

Although the current version is better suited for this simpler type of presentation, Harvard Graphics owners who crave multimedia capabilities should not give up entirely on this package, for its fast and stable HyperShow utility is flexible enough to be used for multimedia purposes. Because you can utilize hyperlinks to launch external Windows- and DOS-based applications, you can play background soundtracks simply by launching a waveform sound or MIDI media player (assuming the latter has the ability to start playing a clip on launch). And with a little bit of skill and SPC's supplementary Windows Video Player module ($15 for registered users), you can play video clips as well. These events can be linked to clickable objects on-screen, to function keys, or to slide transitions.



Attractive charting is among Harvard Graphics' better features for quick, traditional presentations.

EXTRA EFFORT

Getting the video player to work, however, takes a bit of doing. You must first establish which video clip to play (the video player accepts clips in both Windows .AVI and Intel .DVI formats, but not .FLC or .FLI animations), position and size the video window on the computer monitor, and set a few options, such as whether you want to view the control panel or Windows title bar. You can then save the settings in a file and reference this file within Harvard Graphics' "Launch Applications" option. But beware—there are no provisions for looping the video clip, though there is a button bar with basic Stop, Play, Rewind, and Forward functions so you can play a video frame-by-frame or restart it when you reach the end.

Your ability to synchronize soundtracks or voice clips with your visuals is dependent solely upon whatever other Windows tools you have available; Harvard Graphics does nothing for you in this area. Nor does the product give you any help in packaging your presentation:

NO ROBIN HOOD, NO MERRY MEN, NO JAZZ CLUBS, NO GOATS IN PARTY CLOTHES, NO SCENIC AFTERNOONS IN THE COW PASTURE.

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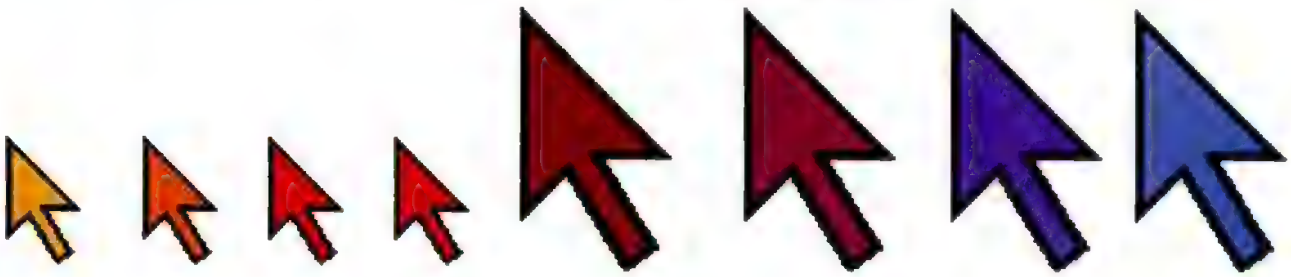

Our chameleon cursor can double in size and change color so it never gets lost. This is another feature you won't get from Gateway. They would rather have you engage in a game of hide-and-seek.

[1]*Performance measured by running WinBench 3.11 at 1024 x 768, 256 colors. Both cards configured with 1MB Video RAM. Dell and Gateway 2000 systems configured with 66MHz 486DX2 processor, 16MB RAM and 256KB*

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Our Resolution Exchange Panel gives you complete control over your desktop environment. And since the VL-Bus links video directly to your powerful 486DX2, your commands are executed instantly.*

*Resolution Exchange Panel and Hawkeye Zoom examples given for #9GXE configured with 3MB RAM (2MB VRAM, 1MB DRAM) and 1280 x 1024 monitor.

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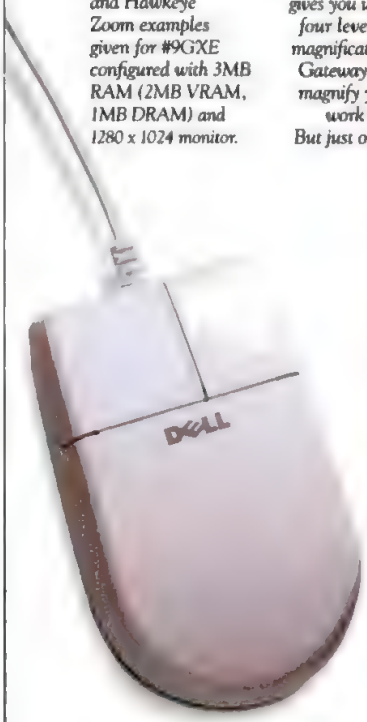
ORIGINAL SIZE



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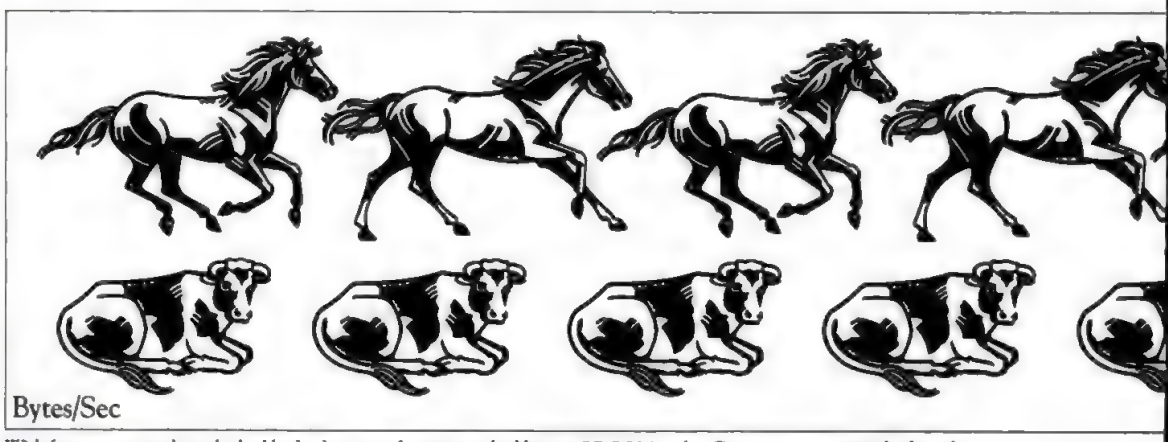
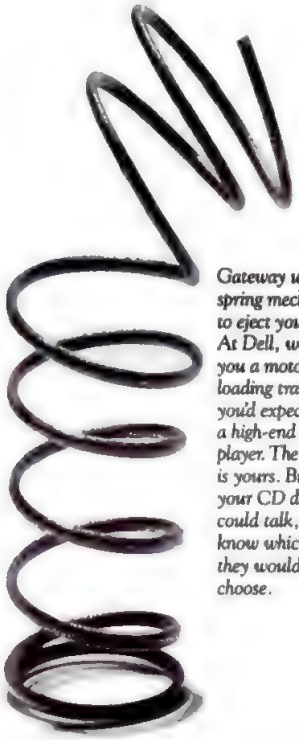
FAST VS HALF-



With faster access and nearly double the data transfer rate our double-spin CD ROM makes Gateway seem positively sluggish.

Thanks to our multi-session CD technology, you can print to disk on as many as four different occasions, storing up to 100 color photographs in all.



Gateway uses a spring mechanism to eject your disks. At Dell, we give you a motorized loading tray like you'd expect from a high-end CD player. The choice is yours. But if your CD disks could talk, we know which one they would choose.

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All comparisons based on manufacturers' specifications. The Dell CD ROM is the Panasonic 563. Gateway's CD ROM is either a LMSI CM205 or a Sony CDU-31A. Dell disclaims proprietary interest in the marks and names of

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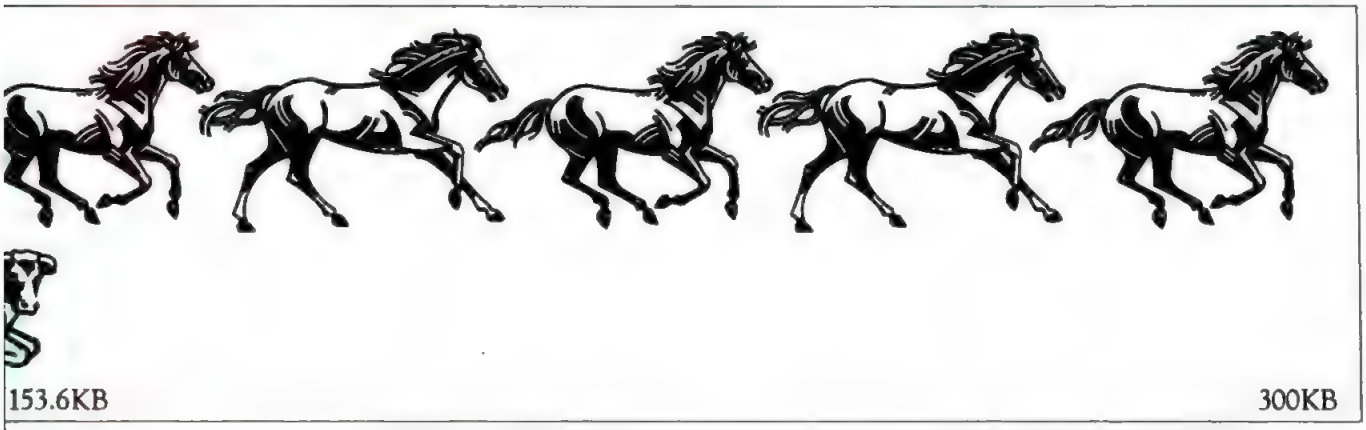

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FACT FILE

Harvard Graphics for Windows, Version 1.03
Software Publishing Corp., 3165 Kifer Rd., Santa Clara, CA 95056; 800-447-7991, 408-986-8000; fax, 408-980-0729

List price: $595
Requires: 386-based PC or better, 4MB RAM, 8MB hard disk space (21MB recommended), DOS 3.1 or later, EGA display or better, Microsoft Windows 3.1.
In short: Harvard Graphics for Windows, Version 1.03, lags behind the times in its lack of OLE support, but with a little ingenuity, you can add a few multimedia functions. It's HyperShow utility and Windows Video Player make it possible to add a few simple multimedia elements to your presentation, but until the next release, which will add client/server OLE support and some special effects capabilities, it's best suited for traditional slide-based presentations.
467 ON READER SERVICE CARD

You must keep track of your media files manually. Furthermore, window positioning is not resolution-independent: You should create your presentation at the same resolution you intend to give it.

Finally, because Harvard Graphics uses a proprietary palette scheme, there is no easy way of matching your presentation color scheme to the palette of your video clips. Thus, you must choose your backgrounds carefully (black is always a good choice) to prevent colorful but distracting palette shifts each time your video clip plays.

As you can tell, all of these expedients to add multimedia capabilities are kludgy. As a result, you'll never mistake Harvard Graphics for a useful multimedia tool. But if you're tied to the product by affection or previous commitment, with a bit of ingenuity you can use it to take the first step into the world of multimedia.

Microsoft Corp.

Microsoft PowerPoint

BY LORI GRUNIN

Unchanged since it earned Editors' Choice when we last looked at presentation graphics products, Microsoft PowerPoint remains a strong tool for creating hard copy–based presentations and text-intensive electronic presentations. But there's no escaping the fact that this $495 package is a wallflower at the multimedia party.

Thanks to its simple single-master approach and easily customized predefined color schemes, you can start producing presentations in no time. A now-familiar array of tools and views—outliner, slide sorter, and notes master—provide most of the flexibility you'll need for creating traditional presentations.

The basic master contains a title and a body text block formatted as a bullet chart; there are no data-chart or graphic templates. You can locally override all master elements, reformat the master, or selectively apply a new template. An eyedropper tool allows you to quickly pick up attributes from one element and apply them to others, and a Replace Fonts feature lets you remap all the fonts in your presentation simultaneously. This is especially useful for changing any Type 1 fonts you've used into TrueType fonts, which PowerPoint will bring along to any other system on which you play your presentation.

The product also supplies an acceptable set of drawing tools. The symbols, which serve as irregularly shaped word-wrapped text boxes, made creating our test organization chart a snap. Although we had to manually create the dashed line by duplicating and aligning a series of small lines, our workaround was more convenient than the 12-step process using Microsoft Graph recommended by the company's FastTips support line.

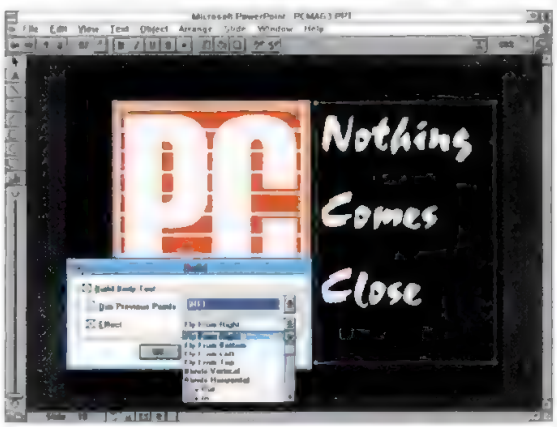
PowerPoint's biggest weak point remains its OLE-based graphing, which uses the same Microsoft Graph server application as Microsoft Word 2.0. This server is especially bad at text handling. For example, in order to fit the numbers 0 through 1,100,000 along the *x*-axis in increments of 100,000, we needed to try a variety of small point sizes incrementally as well as to resize the graph.

Although PowerPoint includes templates for a variety of specific output devices (black-and-white overheads, color overheads, color displays, and 35mm slides), the quality of its color-to-monochrome conversions during printing is fine for all but the most bizarre color schemes.

JOHNNY ONE-NOTE

Clearly, however, Microsoft has made only a token attempt to integrate multimedia handling into PowerPoint. Support for the various media types—.AVI and .WAV files and MIDI clips—occurs through OLE. You can link several OLE objects per slide, but the product does not offer much in the way of playback controls: The object plays when the slide appears, unless you specify a global delay time. Nor can you control the placement of an .AVI movie: It always plays in the center of the screen. And each OLE placeholder appears in your hard copy, unless you hide it behind other graphics on the slide.

While PowerPoint worked fine in our tests using the Microsoft Media Player as an OLE server and supported all of its options—such as hiding the filename that labels the OLE placeholder and showing the control bar on playback—we could not get either the Asymetrix MediaBlitz or Lotus Media Manager servers to painlessly integrate with PowerPoint. The program crashed occasionally, giving a "Memory Too Full" error when an OLE object could not locate its server.



Although Microsoft PowerPoint doesn't offer animation tools, it allows you to add transitions to the text in an automatic build.

The program does not explicitly support .FLI/.FLC clips, and the closest PowerPoint comes to animation is bullet-chart builds with transitions (for exam-

Coming Soon to a PC Near You

by Jeff Greenberg

There are three major desktop presentation software packages that receive the "almost, but not quite" sneak-preview treatment: Software Publishing Corp.'s Harvard Graphics for Windows, Version 2.0, WordPerfect Presentations for Windows, Version 2.0, and Aldus Persuasion. Each promises to make some real inroads in ease of use, image editing, and multimedia capabilities.

Words like *quick* and *advisor* pervade these products as the emphasis on ease of use increases. Toward this end, Harvard Graphics ($495; Software Publishing Corp. (SPC); 800-447-7991) includes an on-screen advisor that guides you through the presentation design. SPC has also added a series of Quick tools: Quick Looks shows you what each icon will do before you use it and what a chart will look like before you graph it; Quick Change lets you modify the appearance of an object with the right mouse button; and Quick Edit lets you change the content of a chart with a double click.

Harvard Graphics has also introduced Desktop Conferencing, which allows users to display their presentation on up to 64 PCs simultaneously via a LAN. In addition to viewing the presentation, members of the conference group can chat with one another, and the leader of the conference can even switch control of the show to another PC.

To make your presentations more visually appealing, Harvard Graphics now allows you to place text along a curved path. You can expect to see this package at your local software dealer by the time you read this.

WORDPERFECT PRESENTATIONS

Outliners and slide sorters are now considered standard equipment for organizing your presentation in most packages, but WordPerfect Presentations for Windows, Version 2.0, ($495; WordPerfect Corp., 800-451-5151) takes this one step further. This new version adds a Slide List that lets you see and modify the slide-to-slide transitions. The package also includes 11 QuickTutors that show you how to accomplish a given task, such as creating a bullet chart, setting up a slide transition, or fitting text to a path.

To add some zest to your presentations, WordPerfect has added an advanced paint module that includes bitmap editing, fills, conversion of vector images, gradient polygons, auto trace, and a Twain interface for scanning. Presentations also lets you display your text characters with a gradient fill.

Words like quick *and* advisor *pervade these products.*

For users craving multimedia capabilities, Presentations features a built-in audio system for recording and playing .WAV files, and the ability to control an audio CD player.

ALDUS PERSUASION

The new focus on ease of use in this version of Aldus Persuasion (Aldus Corp., 800-333-2338; price and date of availability to be determined) is evident as soon as you start the program. Rather than starting with a blank screen, Persuasion, like Freelance Graphics, presents you with a dialog box that lets you run the tutorial, open an existing presentation, or create a new presentation.

Most packages let you use any screen object as a branching button and animate otherwise static screen elements. Unfortunately, you have no way of knowing which objects have these dynamic properties. Persuasion provides a visual clue by displaying buttons next to any screen object (including invisible sound objects) to indicate that the object has nonvisible dynamic properties.

Persuasion has simplified its multimedia capabilities by not only including built-in support for audio, but also by allowing control of most MCI devices without using an OLE server. The package has also inherited some desktop publishing capabilities from its sister package Pagemaker, including kerning, nudge control, and a powerful set of ruler and guide functions. Aldus now provides pictographs and spectral charts that let you color-code regions of your slide according to their values.

Creating a seamless, attention-grabbing presentation means nothing, however, without the ability to deliver it effectively. Persuasion allows you to save your screen annotations as a separate layer, which can be used for group editing of a presentation.

Because some presentations are meant to be self-running and timed to coincide with external events, Persuasion has introduced a feature that lets you set the target duration for a presentation. The time of each individual slide will be changed proportionally, thereby ensuring that your presentation ends on time.

While each of these packages emphasizes different functions, they all promise to make it easier for you to create an attractive presentation every time you power up your PC. □

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FACT FILE

Microsoft PowerPoint, Version 3.0

Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080; fax, 206-936-7329

List price: $495.

Requires: 286-based PC or better, 2MB RAM (4MB recommended), 5MB hard disk space (17MB recommended), EGA display or better (256-color VGA display or better recommended), DOS 3.1 or later (DOS 5.0 or later recommended), Microsoft Windows 3.1.

In short: For producing traditional printed and electronic presentations composed mainly of text and charts, you'll find Microsoft PowerPoint an easy-to-use tool that can fill your needs without any problems. If you need to incorporate more than just an occasional sound bite, however, PowerPoint just isn't up to the mark.

ON READER SERVICE CARD

ple, we had each point fly in from the right). Builds are exceptionally easy to create but are limited to text entered into a Body Text block, and these are limited to one block per slide.

PowerPoint comes with a Windows-based player, the PowerPoint Viewer, which can play native .PPT files without compiling. The program intelligently embeds a bitmap of the first frame of an .AVI clip, so that a missing .AVI file doesn't result in an empty rectangle in your presentation. It would be useful, however, if you could globally override the Locate Media Clip dialog box, which pops up every time the program hits an improperly referenced object as well. Both of our presentations played without problems, and you can use the product's "Madden tool" for interactive annotation.

Though we were able to kludge together a reasonable approximation of the multimedia-intensive presentation we used for testing, it was clear every step along the way that PowerPoint was not designed to handle the task. On the other hand, we breezed through the sections that called for text-based slides and simple transition effects. If your needs run more toward the traditional than the whiz-bang, you'll be more than pleased with Microsoft PowerPoint. □

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Internal Drive Bays	10	8
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24-Hour Technical Support & On-Site Service	Yes	Yes
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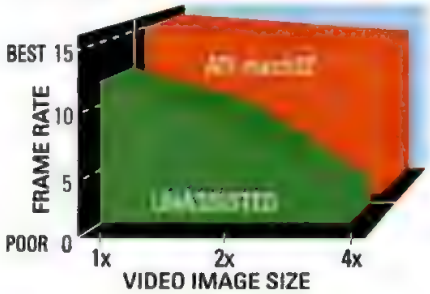

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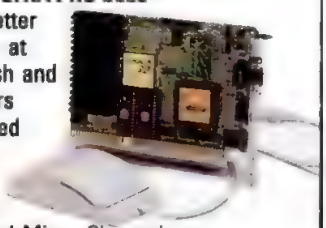

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CIRCLE 228 ON READER SERVICE CARD

RELIABLE NETWORK STORAGE

Protect your data from catastrophe: These six RAID subsystems provide data redundancy and nonstop performance to keep your LAN up and running, even if a hard disk fails.

RAID *to the Rescue*

As PC-based networks have proliferated, replacing even minis and mainframes in some corporations, the need to maintain data integrity and to allow users constant access to the LAN have created a place for a technology called RAID—redundant arrays of inexpensive disks (some vendors substitute *intelligent* or *independent* for *inexpensive*).

Why? Because while hard disks are getting larger and faster, they are by no means immune to failure. Keeping current with the tape backups for your network server's hard disk—just as your disaster recovery plan says you should—avoids

by Bill Taylor

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Photography by Jeffrey Krein

the problem of losing many months' worth of data. But faithful backups won't be enough to help you if you have to bring the server down to replace the failed disk, locate the correct tape to load onto the new hard disk, and then go through the process of restoring your data. While you're doing that, your LAN users won't have access to the information they need to do their jobs. A 1991 Gallup study of Fortune 1000 companies found that every time a network goes down, it can cost an average of $5,000 per hour in lost productivity.

Simply put, RAID is about protecting data in real time from the problems engendered by a server's hard disk failure. The concept of RAID is simple, though it varies in its implementation. The main idea behind RAID technology is to provide data redundancy and nonstop performance. The brainchild of three University of California at Berkeley computer scientists, RAID was originally conceived of in 1987 as a technology that embraced five levels: RAID 1 through RAID 5. Three of these—RAID 1, RAID 3, and RAID 5—are commercially available today. RAID 1 allows for the mirroring of two hard disks with one hard disk controller, and it has been available in NetWare for years. This scheme works quite well for smaller networks, but it can be expensive if you need multiple gigabytes of data storage. Since you are using two disk drives of the same size to store exactly the same data, you will be paying the price of two 1GB drives (about $1,200 each for a Fast SCSI hard disk) for each 1GB of data you need to store.

RAID 3 and RAID 5 are a bit more complex. RAID 3 transfers data in parallel to a set of data disks and a single parity disk, striping data across the data disks in bytes. In RAID 5, the disks operate independently, and parity is spread across all the drives. RAID 3 requires at least two data disks, but works best with four (and one parity disk). RAID 5 works with a minimum of two disks. While no one RAID level is absolutely better than another, RAID 3 is generally considered better for transfers of larger blocks of data, such as graphics or imaging files. RAID 5 is preferred for smaller block transfers the size of typical network files Most of the RAID arrays on the market today for PC-based networks are RAID 5 configurations. Of the six external RAID subsystems tested for this review, only the Ciprico NetArray NA6713-04 did not support RAID 5 but was exclusively a RAID 3 device. Among the other units, the Mylex DAC960 Disk Array Subsystem and the NCR 6298 Disk Array Subsystem Model 1400 supported RAID 1 in addition to RAID 5, while the Storage Solutions RACa-ray 5000 CM-01 supported both RAID 3 and RAID 5.

All the tested units except the Ciprico NetArray also support what has commonly become known as RAID 0. This level, which merely stripes data across multiple drives, was not outlined in the original RAID document and does not contain a feature that gives RAID much of its value: data redundancy. Additionally, some manufacturers (like Mylex) incorporate what they call proprietary RAID modes. While these modes are not without value (for example, Mylex's "RAID

HIGHLIGHTS

RAID

RAID (redundant array of inexpensive disks) technology has become more important as PC-based networks have become more prominent. These arrays offer data redundancy and nonstop performance.

THE ORIGINAL RAID specifications encompassed five levels, from RAID 1 through RAID 5. Of the three RAID levels—1, 3, and 5—that are commercially available today, 3 and 5 are better suited for larger networks. RAID Level 0, which was not in the original specification, merely stripes data across multiple drives and does not incorporate data reduncancy.

RAID 3 IS well-equipped for networks where users transfer larger blocks of data, such as graphics or imaging files. RAID 5 is preferred for smaller block transfers that are more in keeping with the size of typical network files, such as those containing word processing or spreadsheet data.

ALL THE RAID SYSTEMS in this review, with the exception of the Ciprico NetArray, support RAID Level 5.The NetArray is an exclusively RAID 3 device.

SLEDs (single large expensive disks) are certainly less expensive alternatives up-front than external RAID subsystems. RAID 1—simple disk mirroring—connects two SLEDs to a single controller, and keeps a full copy of your data on the second disk.

EQUIPPING RAID systems with load-balancing, redundant power supplies that power the entire system, has advantages over configuring the system with a separate power supply for each drive. With redundant power supplies for the entire system, the failure of a single power supply does not affect the continued operation of any disks.

HARDWARE-BASED ARRAYS, such as those we look at in this review, use a dedicated array processor to offload RAID functions from the server CPU to provide better performance.

ONE FEATURE TO CONSIDER when choosing an array is whether the utilities let the array adjust the resources it dedicates to rebuilding data. That way, if a disk fails during business hours, you can configure the unit to rebuild data while having only a minimal impact on performance.

Our Contributors: BRUCE BROWN is a contributing editor to *PC Magazine.* STEPHEN W. PLAIN is a frequent contributor to *PC Magazine.* BILL TAYLOR is a network consultant specializing in data storage and data communications. MICHAEL J. ZULICH was the project leader for this story.

7"can be useful for networks that deal with huge graphics files), the use of the word "RAID" in their title is misleading and results in confusion for the buyer, especially since that no standards organization has put its stamp on the technology to try to resolve any potential conflicts.

GB FOR GB

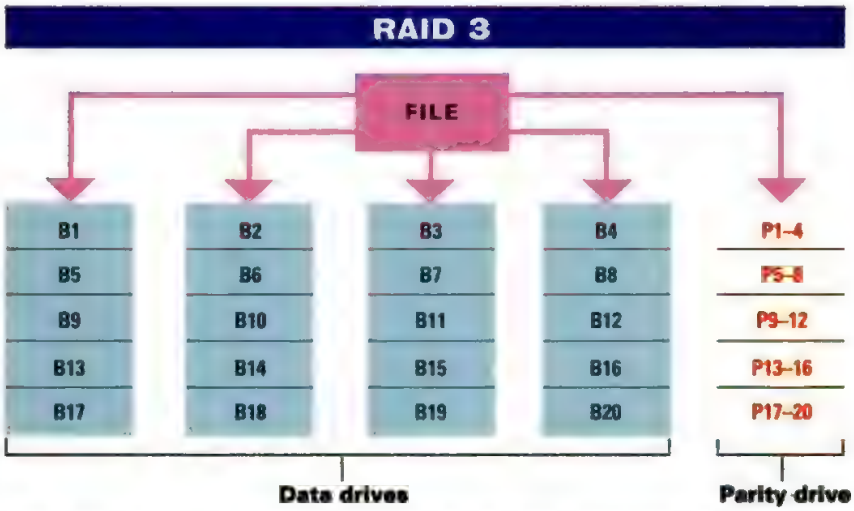
SLEDs (single large expensive disks) are certainly less expensive alternatives upfront than external RAID subsystems (*PC Magazine* will review SLEDs in an upcoming issue). A quick calculation shows that the cost per megabyte for two 2GB SCSI hard disks (typically priced at about $3,000 each) is about $1.50, plus the cost of a SCSI host adapter. The external 4GB RAID arrays in this roundup typically cost about $24,000, or a little less than $6 per megabyte, after accounting for the cost of the SCSI host adapter, chassis, and software usually bundled with these units. (The RAID systems reviewed here ranged from $15,800 to more than $66,000.) But in return, a RAID system gives users continuous access to all data even if a hard disk fails.

In this review, all the vendors have equipped their systems with SCSI disk drives. Even Ciprico, long known for championing of ESDI disk drives for its RAID solutions, has made the move to SCSI. SCSI offers many significant advantages. For instance, with SCSI, one host adapter can control up to eight separate devices (including the SCSI host adapter), whereas the ESDI and IDE standards allow for controlling only two hard disks. Each RAID subsystem reviewed here counts as a single SCSI device. The SCSI data transfer rate is also fast, with Fast SCSI promising throughput of up to 10MB per second, and Fast-Wide SCSI permitting up to 20MB per second over a 16-bit data path. (See "Fast and Flexible: SCSI Technology Grows Up" in the June 29, 1993 issue.)

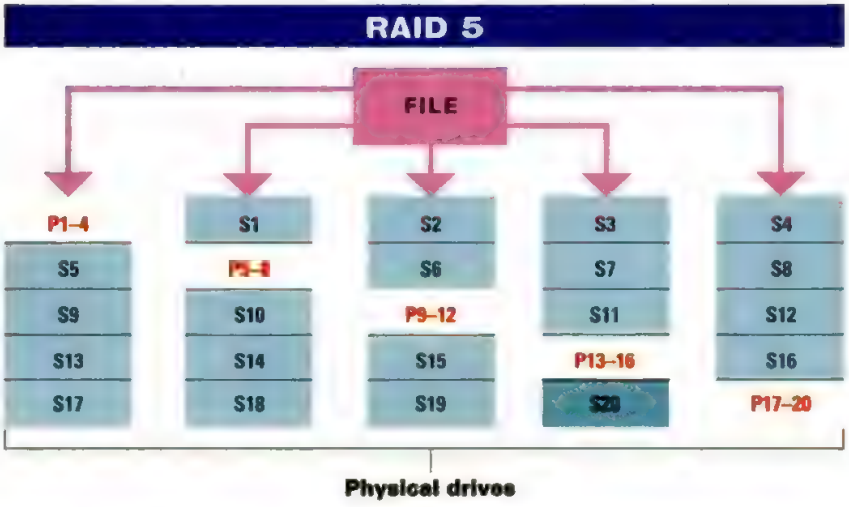
Products have further improved upon the RAID specifications with enhancements such as *hot swapping* or *hot sparing* of disk drives. Neither of these features is defined in any of the RAID level specificiations, but both add substantial performance benefits. Hot swapping means that when a disk drive in the array fails, you can swap it out of the system, replace it with a new disk, and rebuild the data on the replacement disk, all while the array continues to handle data requests from the users. Hot sparing takes this concept one step further. A spare disk drive is placed on-line in the array from the outset. When one disk fails, the array senses the failure and automatically switches to the hot spare, rebuilding data to that drive. Only the Mylex DAC960 implements this feature, though to do so you have to give up some storage capacity. Other products have room enough to hold off-line spare disks.

Most manufacturers in this review—all but Ciprico and Mylex—extend the concept of hot swappability to power supplies. But in RAID systems, the real issue is their arrangement. Some manufacturers—like Mylex, Storage Solutions, and Unbound—equip each hard disk with its own power supply, while Ciprico, NCR,

How RAID Works



RAID 3 stripes data, one byte at a time, across all the data drives. Parity information, used to reconstruct missing data, is stored on a dedicated drive.



RAID 5 stripes data, one sector at a time, across all the drives. Parity is interleaved with data information rather than stored on a dedicated drive.

B1 through B20 represent bytes of data (RAID 3). S1 through S20 represent sectors of data (RAID 5).

P1 through P20 represent the parity bytes (RAID 3) or sectors (RAID 5) derived from B1 through B20 or S1 through S20.

and Storage Dimensions rely on redundant load-balancing power supplies that power the entire system. Storage Solutions actually adds a redundant load-balancing power supply to its controller in addition to the power supplies for each disk.

Although equipping each disk with its own power supply may seem like an effective way of adding extra protection, it doesn't offer many of the advantages of a redundant load-balancing power supply for the whole system, and it has potential disadvantages as well. For instance, with redundant power supplies for the entire system, the failure of a single power supply does not affect the continued operation of any disk in the array. But when each disk has its own power supply, the failure of that power supply makes the disk unavailable to the system. Having a power supply devoted to each drive can also create a good deal of unwanted heat, and heat is the enemy of electronics.

REVIEW CRITERIA

For this review, PC Magazine tested six standalone external RAID subsystems that support NetWare 3.11 networks and RAID 3 or 5 specifications, or both.

We also required these products to be hardware-based arrays—that is, that they use a dedicated array processor to offload RAID functions from the server CPU to provide better performance. We looked only at products that support background rebuilding of failed disks and that allow you to swap a failed disk for a new one without bringing down the system. Finally, we required any products that rely on NetWare drivers to use certified NetWare drivers and to support a total unformatted storage capacity between 4GB and 8GB. (After testing, however, we found out that Ciprico's NetWare 3.11 drivers were not yet certified, although the company expects to correct that by the time you read this.)

Products that met this filter but could not be sent in time for testing were Sanyo Icon's LANser MRX100 ($26,225), the Peak Technologies Group Model FA-7040/S ($27,500), Corp.'s StorageWorks RAID Array ($20,800), and CORE's LANArray ($19,995).

In May Hewlett-Packard began shipping its $14,899 hardware-based HP Disk Array, and CompuAdd began shipping its DriveArray; a RAID 0, 1, and 5 system that can store 8GB, it is priced from $7,495. Raidtec Corp. has been shipping its $4,950 FlexArray IX since January 1993. And IBM expects to introduce its RAID offering—the PS/2 Server 95, which has an integrated RAID subsystem—in the third quarter of 1993.

In the sidebar "RAID: Software-Based Options" we look at software-based RAID implementations from Micropolis, Chantal Systems, and Legacy Storage Systems; in a software RAID, the dedicated array processor is replaced by control programs that run under NetWare as NLMs. By the time you read this, Corel will be shipping its CorelRAID, a $995 software package that supports RAID Levels 4 and 5 and works with almost any hard disk. And Microsoft Windows NT Advanced Server will also include RAID Level 5 support.

Alternatively, you can opt for complete PC systems that host RAID subsystems. Two such examples are Dell's 4033XE/DSA ($13,941 with 4GB storage) and Compaq's ProSignia Model 486DX2/66 ($12,969 with 4GB storage). The CORE MicroArray offers another

PC MAGAZINE

EDITORS' CHOICE

- **Mylex DAC960 Disk Array Subsystem**
- **Storage Dimensions LANStor Continua Disk Array**

RAID is a technology whose time has come. With the growth of PC-based networks in the workplace, more users than ever are relying on servers for storage—and that means it's more important than ever to maintain data integrity and to allow users constant access to the network . . . even in the event of a disk drive failure.

In this review, two RAID solutions stand out for meeting these needs: the Mylex DAC960 Disk Array Subsystem and the Storage Dimensions LANStor Continua Disk Array.

The $20,000 4GB Mylex unit that we tested brings a wealth of features to the table: RAID Level 5 support, a flash EEPROM to make upgrades easier, and setup flexibility in the form of DOS-based configuration utilities that allow you to set up multiple physical packs of disks with various sizes, RAID levels, and cache policies.

The flexibility of the Mylex DAC960 makes it suitable for environments where diverse storage requirements exist. The unit is also the only one in this review group that gives you the choice of housing an on-line spare disk. An optional $345 NetWare kit packs the requisite monitoring and system administrator utilities but lacks the ability to let the user set rebuild parameters.

What really makes the Mylex unit shine is its showing on our throughput tests. The DAC960's performance is helped along by an Intel 80960 RISC processor and 16MB of cache RAM that sits on the combination Fast SCSI host adapter/array processor. An NLM helps matters by incorporating an algorithm to avoid conflict with NetWare's own cache. Performance was exemplary in almost every way: the unit received top scores on all of PC Labs' throughput tests. Though the Mylex has some drawbacks—for example, it doesn't provide power redundancy; it wasn't the easiest unit to install; and removing disks and power supplies is a little more cumbersome than with other units—all in all, it offers a high-performance solution to NetWare users' data storage and data integrity needs.

LANStor CONTINUA

Sterling performance is only one part of the RAID equation; reliability and accessibility are equally important.

Though the throughput of this RAID 5 unit is less impressive than that of the DAC960 (due chiefly to a bottleneck at the internal array controller), the Storage Dimensions LANStor Continua makes for a dependable and very accessible RAID solution. Priced at $23,945 for 4GB of fault-tolerant storage, the unit proved the easiest system to set up and install. In fact, of all the units tested, only the LANStor Continua proved itself amenable to setup and use without aid from the company's technical support staff.

Among the various features in the compact LANStor Continua's favor are its redundant, load-balancing power supplies and a modular design that makes it easy to remove failed disks or power supplies and install new ones while the system is up and running. While it doesn't allow you to use replacement disk drives in other sizes from different manufacturers (as the Mylex system does), the Continua benefits from a series of NLMs that are well integrated with NetWare and emulate the same bar-menu approach that many of NetWare's own utilities have. You can also customize the parameters to be used during the rebuild process—indeed, the Continua turned in some of the best rebuild times with and without network activity present. Choose the LANStor if ease of use and customizable options are more important to you than the highest throughput.

twist: This disk array is an $8,495 unit that packs 840 MB of storage into 2.5-inch storage modules in a casing that mounts in any host's 5.25-inch bay or standard drive enclosure; a 1.3GB version should be available by the time you read this.

PERFORMANCE RESULTS

Increasing performance was not a primary goal in the original RAID specifications, but a well-thought-out and manufactured RAID array can provide you with substantial throughput.

The NetArray, the RaidSTOR-T3, the NCR 6298, and the RACA-ray 5000, for instance, offer spindle synchronization for a performance boost. This can increase throughput up to 20 percent in RAID 3 arrays and about 10 percent in RAID 5 simply by using the sync pulses of one of the hard disks to sync all of the hard disks together. The benefit is that there is no waiting for one or more of the disks to seek to the correct location; rather, all the drives seek together. Dual-ported memory on the array processor—a feature implemented by the NetArray—gives the array controller the ability to access commands issued by the network operating system without the need to do a DMA (direct memory access) transfer to the PC bus, freeing the PC bus to transfer data uninterrupted.

Both Mylex and Unbound offer a high-speed CPU RISC processor, the 25-MHz Intel 80960, on their arrays. Mylex has also equipped its controller with 16MB of cache RAM. While other vendors in this review, such as Unbound and Storage Solutions, offer the option to equip their array processors with multiple megabytes of cache RAM, not all vendors encourage the move. The reason is that network operating systems such as NetWare have already incorporated features such as caching to improve performance, and the possibility of conflict between NetWare's cache and the array controller's cache is very real. Such a conflict can slow down data transfers. Mylex neatly avoids this situation with a proprietary algorithm in its NLM.

RAID arrays do not take the place of regularly scheduled system backups. Erased files will be just as gone.

With such features as its 16MB cache and RISC processor, the Mylex DAC960 was the fastest performer on our Sequential Read and Write and Random Read and Write tests. The DAC960 bested the competition neatly on nearly all fronts, exhibiting only a noticeable drop on the Random Write test with one failed drive. This indicates that the system's preset dynamic rebuild parameters allocate more network resources to disk rebuild time than to disk performance during the rebuild.

In contrast, the Storage Dimensions LANStor Continua delivered the slowest throughput performance of the pack, in large part because of a bottleneck at the internal array controller. The company plans to correct this with revisions to its driver, but in the meantime, the LANStor shines on other fronts. It turned in some of the best rebuild times, with and without network activity.

One of the features you'll want to look for in a RAID array is the ability of its utilities to adjust the amount of time the rebuilding process takes away from users on the network. For example, if a disk fails during normal business hours, you'll want to reconstruct your data with as little an impact on performance as possible. A good rebuild utility might allow you, then, to allocate 80 percent of system resources to servicing user I/Os and 20 percent for background rebuilding, or it may allow you to set time slices and block sizes to favor the most rapid drive reconstruction or the best user response. All but the DAC960 allow you to set some kind of rebuild parameters.

Despite all the units' facility at rebuilding failed disks, RAID arrays *do not* take the place of regularly scheduled system backups. Files that are erased from a RAID array are just as gone as they would be from any other storage device. If you have to restore a file to the network because of accidental deletion, the only way to do it reliably is from a backup of your own system. Among the units reviewed here, the SSI RACa-ray 5000 does the best job of emphasizing the importance of backup; our test unit included an 8GB SSI DATa-bak8 DAT drive in its $27,995 price.

SOME CONSIDERATIONS

When choosing an array for a NetWare network, make sure that both the drivers and the SCSI controllers are NetWare-certified; that is, that the primary connection to the network has been tested by Novell to function properly as a large disk device. An ill-behaved NLM can cause the entire array to dismount if it has improperly negotiated the transaction sent from the array to the SCSI controller. Of-

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HEWLETT PACKARD

CIRCLE 244 ON READER SERVICE CARD

With the benefit of features such as an Intel 809606 RISC processor and 16MB of cache, the Mylex DAC960 was the fastest of the RAID 5 units we tested on our Sequential Read and Write tests and Random Read and Write tests. The Ciprico NetArray, a RAID 3 array, was the fastest performer overall; this can be attributed to its RAID level and the greater amount of memory in its test-bed server.

What the Numbers Mean

Disk reads and writes are directed first to cache buffers and then to the disk. To ensure that most reads and writes would access the disk and not the cache, we chose to use a 1MB test file for each of the 32 workstations.

The Ciprico NetArray NA6713-04, the only RAID 3 device in the group, took a minimum of 52MB of server memory just to mount the four test volumes. As a result, we had to configure the Compaq Systempro with 64MB of memory—the next-largest size that the Compaq would accept. To make sure that the reads and writes would access the disk as they did for the other tested units that offered 4GB or less of fault-tolerant storage, we then increased the test file size to 4MB on each of the 32 workstations, for a total of 128MB of test files.

Unfortunately, at this level the NetArray was unable to complete all the tests and caused the network to fail. Ciprico could not solve the problem but expects to have a solution in place by the time its driver is submitted for NetWare certification. The performance of the remaining units showed the effect of available disk cache on disk throughput. When tested on the sequential file suite, the Mylex DAC960 Disk Array Subsystem—which has a proprietary Fast SCSI disk controller equipped with an Intel 80960 RISC processor and 16MB of cache—surpassed the competition by a wide margin.

The Storage Dimensions LANStor Continua Disk Array suffered from a peculiarity of the BusLogic-licensed noncaching Fast SCSI disk controller, which was unable to deliver performance above 5MB per second on our NetWare 3.11 network. In addition, the internal array controller experienced difficulties that reduced throughput to and from the disks (Storage Dimensions is working on driver revisions to solve this problem). Though the LANStor was the easiest device to configure and operate, it had the slowest overall read and write performance of the arrays in this review.

On the Sequential Write Test the Mylex DAC960 Disk Array Subsystem took the performance lead again, with a throughput of 173.2K per second—more than three times as fast as the next-fastest device, the Storage Solutions RACa-ray 5000 CM-01, which scored 55.8K per second. Only one machine, the LANStor Continua, did not exhibit as steep a drop as the others from read performance to write performance, which shows the strength of fusing sequential read and write commands.

Throughput performance on the Random Read test showed that the Mylex was still on top, handling 123.7K per second.

Though the Mylex, with its throughput of 53.3K per second, was the fastest system on our Random Write test, the NCR 6298 Disk Array Subsystem Model 1400, which had a throughput of 52.5K per second, performed nearly as fast. But keep in mind that the NCR unit, among other features, has an MCA host and more disks than any other system (20).

The time it takes to rebuild a disk is affected by disk usage and the amount of system utilization allocated to the rebuild process. Most of the devices tested use a foreground-to-background task mix, which is designated in time slices and block sizes. In contrast, two of the RAID systems, the Mylex and the Unbound, use dynamic rebuilds that adjust the time slice and block size according to current network use and a predetermined algorithm.

Under a test scenario in which no network load represented the fastest possible rebuild, the NCR 6298 was a clear winner, taking only 3 minutes 36 seconds. Set for a 0.1-second time slice and a 4MB block per interrupt, the NCR was nearly twice as fast as the next-fastest unit. But since the NCR has 20 236MB disk drives, speedy rebuilds should be expected. Coming in at the low end of our test range, the Storage Solutions RACa-ray 5000 took 22 minutes 21 seconds to rebuild a 1GB drive using a 0.1-second time slice and 256K blocks.

Under a network load representing the best possible mix of network performance and rebuild time, the NCR 6298 again claimed top honors. With rebuilds set for a 2.0-second time slice and a 1MB block per interrupt, the NCR took 20 minutes 33 seconds to complete the rebuild. The Storage Solutions RACa-ray 5000 took 1 hour 22 minutes 8 seconds to rebuild the 1GB drive, which made it the slowest of the arrays tested.

On our Random Write test (with one failed drive), three of the test units—the NCR 6298, the Storage Dimensions LANStor Continua, and the Unbound RaidSTOR-T3—registered very little performance degradation: Each of these RAID units showed less than 5 percent variation from the score it garnered on the Random Write test. Even with one failed drive, their performance that was nearly identical to that of a perfectly operating system. In contrast, the Storage Solutions RACa-ray 5000 and the Mylex DAC960 suffered substantial performance degradation in the failed drive mode.

How We Tested

We tested each of the RAID units over a Token-Ring network of 32 workstations and one server running NetWare

3.11. With two exceptions, the RAID units were tested using a Compaq Systempro equipped with 16MB of RAM and four 16MB EISA-based Madge Straight Blue 16/4 Token-Ring Adapter cards. For the first exception, the Ciprico NetArray NA6713-04, we equipped the Compaq Systempro server with 64MB of RAM and the four 16MB EISA-based Madge Token-Ring cards. The other exception, the NCR 6298 Disk Array Subsystem Model 1400, used an IBM PS/2 Model 95 server with 16MB of RAM and two 16-megabit IBM Token-Ring MCA-based boards. Two network segments—the maximum the Model 95 supports—were created on the PS/2.

We installed four NetWare volumes in each RAID unit (a volume is similar to a DOS partition), and each volume was then loaded to 50 percent of its storage capacity. The setup and load emulated real-world usage as closely as possible and forced each drive's read/write head to traverse beyond the inner few cylinders of the disk.

We used Version 2.06 of PC Magazine Labs' NetBench test suite. The testing required each of the 32 workstations to create, write, and read files of various sizes on each of the RAID systems. We reported the throughput on the Sequential Read and Write and the Random Read and Write tests for a 1MB file using a 1K block size.

We recorded the time it took to rebuild a failed drive with and without network utilization. We also recorded device throughput with one failed drive. Random writes, using 1MB files and 1K blocks, were performed on each array while one of the array's drives was in "failed" mode (that is, physically removed from the array).

For the **Sequential Read** and **Sequential Write** tests, each test file created on the server by the test station is read or written one block at a time. When the file operation is complete, the test sequence starts over and continues. Each read and write operation is repeated for a 10-minute test interval during which I/O throughput is recorded.

For the **Random Read** and **Random Write** tests, each test file created on the server by the test station is read or written one block at a time. The relative "start point" of the read or write is randomly determined by each test station. This process is repeated for a 10-minute test interval during which I/O throughput is recorded. An attempt to read or write beyond the end of the file size allocated is not permitted.

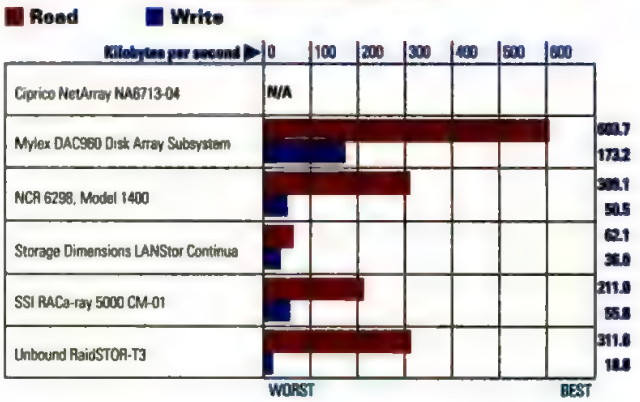
The **Random Write** test (with one failed drive) measures the I/O throughput of random writes with one drive in failed mode (removed). Write operations are repeated for a 10-minute test interval during which I/O throughput is recorded.

Rebuild (No Load) measures the time required to rebuild a RAID disk drive without any network or array use.

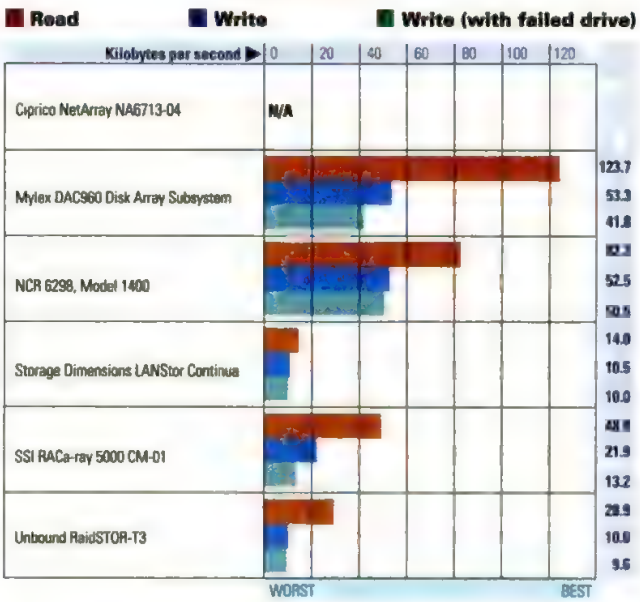
Rebuild (Load) measures the time required to rebuild a RAID disk drive while the network and array are in use. To simulate a network load, we perform sequential reads and writes and random reads and writes on the array while the rebuild is in progress.

AVERAGE THROUGHPUT (1MB file, 1K blocks)

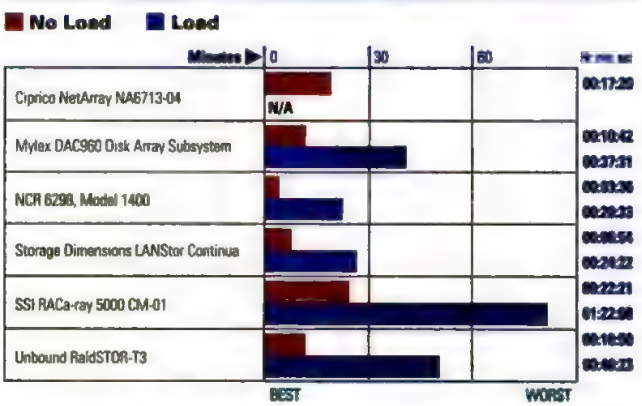
SEQUENTIAL



RANDOM



REBUILD



N/A— Not applicable: The unit was unable to perform this test.

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ten vendors simply include standard SCSI controllers from companies such as Adaptec, BusTek, or Distributed Processing Technology (DTP); the exceptions are Ciprico and Mylex, which supply SCSI controllers of their own design and manufacture. Though the Ciprico SCSI controller wasn't NetWare-certified at the time we tested, Ciprico expects to have it certified by the time you read this.

You should also consider where you can go to obtain replacement hard disks and what types of disks you'll be able to use. Most disks will not fail for 3 to 5 years, and by that time the models you have sitting in your array may no longer be in production. Ciprico and Mylex allow you to buy replacement disks from many third-party manufacturers (though you can purchase them from these vendors as well); also, these replacement disks needn't be of the same capacity or from the same manufacturer as the disks originally in the array. The other manufacturers in this review require you to replace failed disks with disks of the same size and from the same manufacturer. With the exception of Unbound, you'll need to purchase the disks from the RAID vendor.

Neither RAID 3 nor 5 can tolerate two failed hard disks at the same time. You'd be wise to keep a spare.

No matter how the RAID vendor you choose handles its storage requirements, you'd be wise to keep a spare hard disk sitting on the shelf for any emergency. Having a spare hard disk also will help you in another critical area: Neither RAID 3 nor 5 can tolerate two failed disks at the same time. Should a second drive fail while you are waiting for the replacement drive, all of your expense and planning will be for nothing: Your data will be lost when the second drive fails.

It's also worth preformatting the spare disk before a crash occurs. All the vendors in this review allow you to preformat disks (in fact, Storage Dimensions sells only preformatted drives), but some—such as Ciprico and Mylex—also give you the option to format at rebuild time. If you choose that route, the rebuild time will be much longer.

Finally, consider the level of technical support available with your RAID system. Most of these units are sold by VARs or by OEMs or both, so be sure to buy from a firm whose service policies you trust. While all of these companies offer telephone technical support, only the ones that sell direct to the end user offer free on-site installation and support. Since on-site installation can greatly enhance the successful setup of a RAID system, confirm what level of service and support the company you plan to buy from will give you.

Ciprico Inc.

Ciprico NetArray NA6713-04

BY BRUCE BROWN

Ciprico's NetArray NA6713-04, the only 8GB array in this review, is also the only exclusively RAID Level 3 subsystem in the group. The NetArray provides a welcome level of flexibility, particularly in the choices it offers for replacing failed disks. But, the unit we reviewed had two problems: its Novell drivers lacked certification (Ciprico says that the drivers will be certified by the time you read this), and the unit was unable to complete our series of throughput tests.

Ciprico NetArray NA6713-04

In the NetArray, both the array controller and the host adapter are designed and manufactured by Ciprico.

VB Power

ISBN: 1-56276-073-4
Price: $34.95

This innovative guide by Dan Appleman turns Visual Basic programmers into power users by illuminating the tools of the Windows Application Program Interface (API). Includes a time-saving disk that contains source code from the examples in the text, plus a specially designed dynamic link library (DLL).

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RAID: *Software-Based Options*

by Stephen W. Plain

The RAID systems in the main section are hardware-based: A dedicated processor, like a Motorola 68020, is housed on an internal array controller board or on the SCSI host adapter. It executes programs that perform functions specific to the array, such as SCSI bus transfers and data reconstruction. But most of these functions can also be executed by the server's processor. And that's the approach of the two software RAIDs discussed here.

In a software RAID, the array controller board is replaced by one or more control programs that, under NetWare, run as NLMs. Software arrays have some potential advantages in terms of price and performance scalability. Presumably you will have your RAID system for many years; during that time you may upgrade your server's processor at least once. While some hardware-based arrays will still be using 25-MHz 68020s, a software RAID could benefit from a Pentium.

Some performance concerns, however, stem from the RAID software's reliance on NetWare for processing resources. If the file server's processor does all the thinking for the software RAID, how much processor time is open for other applications and user requests? Software RAID manufacturers contend that under NetWare the file server's processor is grossly underutilized in normal operation. This is true for file servers acting as storage devices, but other instances are not as clear. Take, for example, a typical high-end database client/server setup: the database engine runs under NetWare as an NLM and vies for processor time with the RAID.

Another concern is system stability. With the brains of the RAID running as one or more NLMs, how susceptible is it to damage from an ill-behaved server application? For NetWare, the answer is sobering. All NLMs run at essentially the same level as the operating system: ring 0. Hence an NLM can issue improper requests to areas of memory being used by other programs. Indeed, hardware-based RAIDs that use NLMs to communicate between NetWare and the hardware carry the same risk. To limit this risk, use only Novell-certified NLMS on your server.

MICROPOLIS RAIDION

The Raidion, from Micropolis (800-358-7243), consists of RaidWare 2.0 software and an array of independent but easily stackable SCSI modules; each holding a 5.25-inch Micropolis hard disk, power supply, and fan. With multiple SCSI host adapters, RaidWare can handle up to 28 modules and offer 47GB of RAID Level 5 storage. Pricing is also modular. The software is included when you buy three modules. A 1GB module costs $3,160; a 2.1GB module, $4,550. An ISA Adaptec SCSI host adapter lists for $473, an EISA version for $850.

One drawback of the modular structure is that the power supply and SCSI bus are daisy-chained between modules. To replace a module, you must briefly suspend all others on that chain from operation by pausing the SCSI channel through RaidWare. However, RaidWare 2.0 lets you designate a module as a hot spare. For OS/2, Micropolis sells the Raidion LT, which has modules that plug into a common backplane; this lets you hot-swap drives without pausing the SCSI channel.

On the Sequential Read and Write tests, the Raidion scored below average compared with the other hardware arrays: 114.9K per second and 19K per second, respectively. On the Random Read and Write tests, however, it scored a fast 210.4K and 81.7K per second, respectively. This can be attributed to the Raidion's requiring 32MB to be mounted by NetWare, which leaves a greater amount of cache RAM available. The Raidion took 38 minutes 26 seconds to rebuild a drive with no network load. Under load, the rebuild stretched to 2 hours 54 minutes 46 seconds.

CHANTAL AND LEGACY

Paragon software, sold by Chantal Systems (a division of BusLogic; 619-621-2810) for $995, consists of several NLMs offering RAID 5 fault tolerance for use with a range of host adapters and SCSI hard disks. We tested the M.A.S.S. HFD/XE system (made by Legacy Storage Systems; 508-435-4700), which pairs Chantal's Paragon with a tower case holding four 1.4GB hard disks. Legacy modifies Seagates and Hitachi hard disks for use with its units; our test unit used Seagate drives. The tested system lists for $20,899 with an Adaptec SCSI host adapter, about $5,000 more than the lowest-cost hardware RAID solution we saw.

Unlike RaidWare, Paragon supports hot-swapping of its on-line spares when the hardware can take advantage of that feature (as can Legacy's unit). It can also pause the SCSI bus for systems that don't support hot swaps.

Paragon's setup program detects the system's host adapter and places the proper drivers in the NetWare startup. VDISK lets you set up virtual disks as individual RAID devices.

Similar to the "fusion" tactic of Storage Dimensions' LANStor Continua, Paragon's ISJC (Intelligent Stripe Job Combination) combines multiple random write requests of the same stripe width into one write.

In testing, the Legacy scored its best on the Sequential Read test (222.5K per second). The Sequential and Random Write scores were below average (30.1K and 17.5K per second, respectively). The unit took 55 minutes 23 seconds to rebuild a 1GB drive with no load; under load it took 1 hour 43 minutes 35 seconds. □

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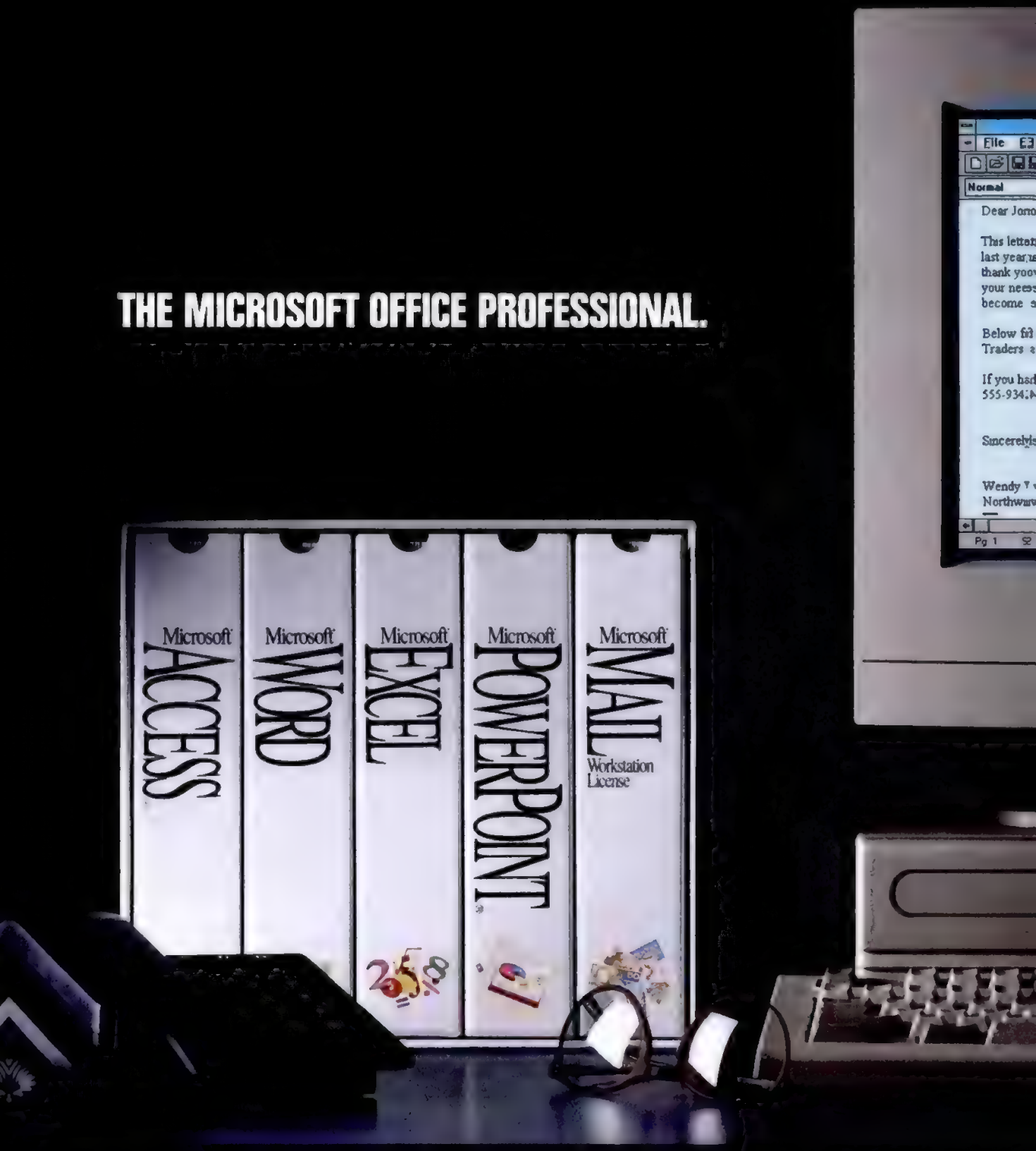

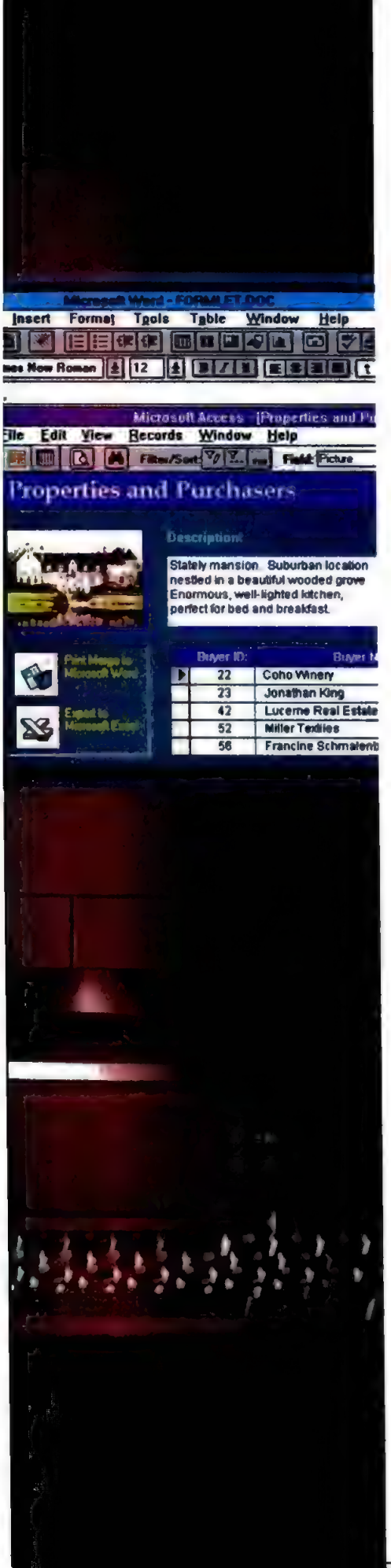

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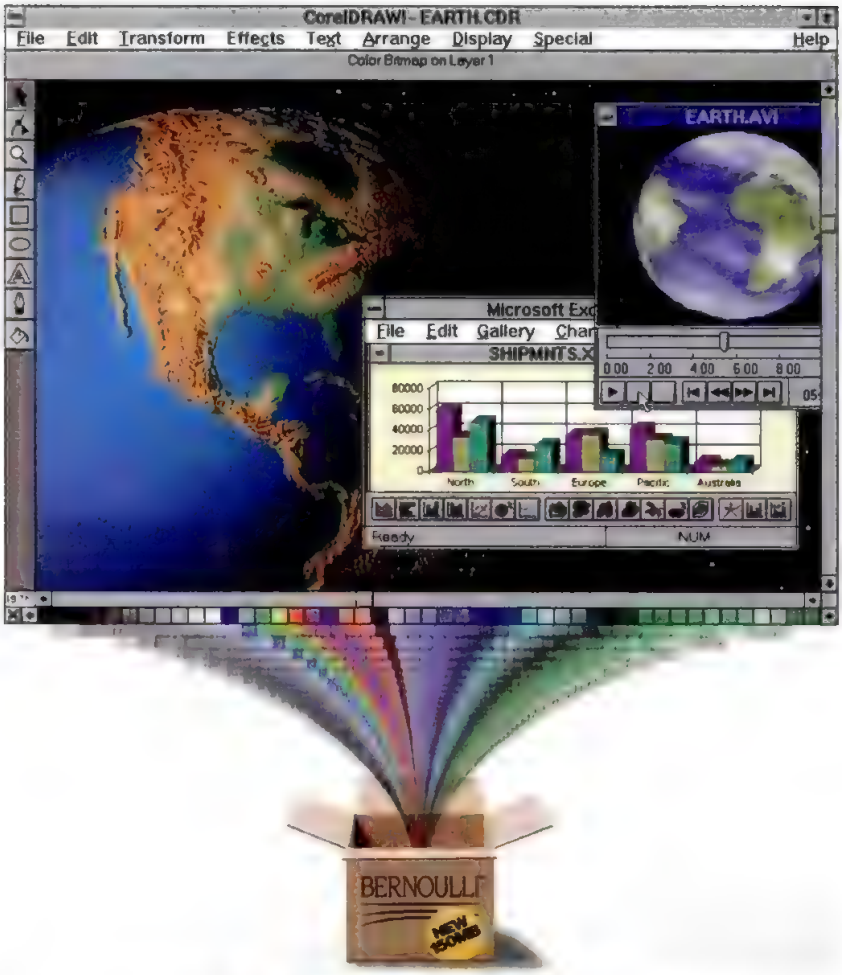

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CIRCLE 378 ON READER SERVICE CARD

FACT FILE

Ciprico NetArray NA6713-04

Ciprico Inc., 2800 Campus Dr., Plymouth, MN 55441; 800-727-4669; 612-551-4000; fax, 612-551-4002

List Price: $37,995 with NA6710 NetArray, nine HP C2247 1GB hard drives, Rimfire 5600 SCSI adapter card, SCSI cable, terminator, redundant power supply, REBUILD NLM 1.0, RFDRVR DSK 3.0, RFAMON NLM 1.0.

Options: With single power supply, $36,495; with five 1GB disk drives, $25,995

In short: One of the advantages of the Ciprico design is that the company serves as a single source for almost all the pieces. The NetArray also offers good value in terms of its features and flexibility, but the unit was unable to complete our throughput tests and, at press time, lacked NetWare-certified drivers (though it should have the latter by the time you read this).

469 ON READER SERVICE CARD

The 8GB unit includes the array box with nine 3.5-inch 1GB disks (ours used Hewlett-Packard C2247 Fast SCSI disks, each with a 256K buffer), a Ciprico Rimfire 5600 adapter card, and a SCSI-2 cable and terminator. The Ciprico array controller has a 20-MHz Intel 80186; NetWare NLM files for disk rebuilding and for monitoring and configuring the array are included. Pull-down menus and a 16-character LCD make configuration easy.

The $37,995 test unit came with the redundant power supply recommended by Ciprico and an 8-bit Fast SCSI EISA interface (also available in MCA or ISA versions). An upcoming 16-bit interface card will support Wide and Fast SCSI. You can daisy-chain up to seven arrays. A five-disk 4GB configuration with the redundant power supply, which costs $25,995, was not available in time to test. You'll need to make sure that your host file server is equipped with a minimum 52MB of system RAM in order to enable NetWare to mount an 8GB array. When dealing with such a large-capacity array, most file servers (such as the Compaq Systempro) require you to have 64MB. But even with 64MB installed in the Compaq Systempro test-bed, we were unable to get the NetArray to perform our throughput tests. Ciprico was unable to solve the problem in time for this review, but the company is working on it.

FLEXIBILITY FIRST

When a disk fails, an alarm sounds and a message appears on the LCD panel. Notification is also sent to the file server monitor, the system administrator's system, or to active network nodes. To replace a disk, you simply unlock the array case, pull out the bad drive, insert a new disk, and push the rebuild button on the array keypad; all this happens with the array on-line.

The rebuild configuration utility lets you specify whether to let the rebuild use 10 percent, 50 percent, or 99 percent of the system resources. On our Rebuild test with no load, the NetArray took a somewhat long 17 minutes 20 seconds to complete the task.

With NetArray, you're not restricted to replacing a failed disk with the same model or the same size disk, or even with a disk from the same manufacturer. As long as the new disk is the same size or larger than the failed disk, you should have no problems; though if you install a larger-capacity disk, the extra megabytes beyond the formatted capacity of the other disks won't be used. You can buy replacement disks from Ciprico or many third-party manufacturers.

You can't hot-swap a failed power supply in the NetArray, but two large load-leveling 450-watt devices do give this system extra protection.

The two power units are enclosed in a module that sits under the array box, which in turn rests on top of the unit in a tower style.

This redundant power supply module extends the unit's height to 25 inches and the width to 9.2 inches. You can also buy a unit without a redundant power supply; with a single power supply, the tested configuration costs $36,495. When you have a single power supply, you can position the array component horizontally or vertically; you can also order the array with a rack-mount enclosure for the same price as the tower unit.

The problems we had in testing the unit and the lack of certification for the Novell drivers at review time are issues of concern. But in other respects, the 8GB Ciprico NetArray offers value in the form of well-implemented features and flexibility.

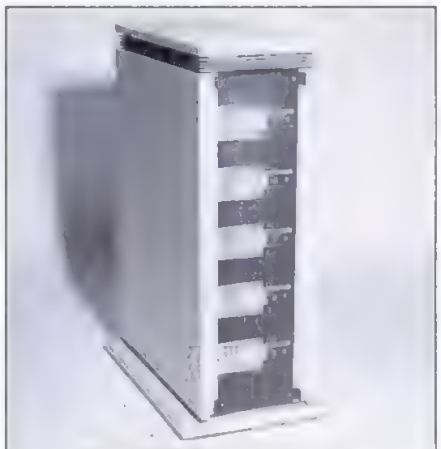
Mylex Corp.

Mylex DAC960 Disk Array Subsystem

BY STEPHEN W. PLAIN

When Mylex designed its DAC960 Disk Array Subsystem, it engineered a logical marriage between its high-performance SCSI caching controller and a tower of disks. The well-built unit that resulted delivers notable flexibility, making it a strong choice for users with diverse storage requirements.

The Mylex DAC960 is the only system in this review group that combines a dedicated array processor with an 8-bit EISA host adapter that installs in the server. It has a 25-MHz Intel 80960 RISC processor and 16MB of cache RAM. A flash EEPROM makes field ROM upgrades easy and saves the current disk configuration in the event of a failure. A 4GB fault-tolerant system for NetWare is $20,000, plus $345 for the optional NetWare kit.


Mylex DAC960 Disk Array Subsystem

A Fast SCSI daughtercard provides five SCSI channels. The cabling scheme is a bit awkward, though: Five separate ribbon cables run from the daughtercard to a junction box that mounts to the back of the host system over the top of two slots. With four Token-Ring adapters in our Compaq Systempro, we did not have enough room to install the junction box properly.

The five disks are housed in a five-tier tower case that is 30.5 inches high, 13 inches wide, and has one 5.25-inch SCSI disk and one power supply per level.

Glossary: The Word on RAID

array Two or more hard disks that read and write the same data. The operating system treats an array as if it were a single hard disk.

dedicated array processor A processor on a hardware-based array that controls the execution of array-specific functions, such as rebuild parameters.

duplexed Refers to two hard disks that have separate disk controllers and are mirror copies of each other. Data is written simultaneously to both.

hot swap The process of replacing a failed RAID drive with a new drive while the rest of the disks continue to provide data to the network users.

load balancing The use of multiple power supplies within a disk array so that power usage is spread equally across all the power supplies. The failure of one supply will not cause the entire array to fail.

parity The combined (XORed) binary value of the original striped bytes or sectors, used to recover data from a failed drive.

RAID (redundant array of inexpensive disks) A disk subsystem architecture that writes data across multiple hard disks to achieve redundancy.

RAID 0 A disk subsystem architecture for writing data across multiple hard disks. Not part of the original 1987 RAID design, RAID 0 lacks redundancy.

RAID 1 A disk subsystem architecture that incorporates *mirroring*. Two hard disks are connected to the same controller; data is written simultaneously to both. If either fails, the array continues to function.

RAID 2 A disk subsystem architecture that writes data across multiple disks, adding Hamming code error detection and correction. In RAID 2, an array of four data disks requires three parity disks of equal size. RAID 2 offers the greatest redundancy but is not cost-effective; no commercial implementations exist.

RAID 3 A disk subsystem architecture that stripes data one byte at a time. Parity is calculated on a byte-by-byte basis and stored on an extra drive.

RAID 4 A disk subsystem architecture that stripes data in sectors; an extra drive stores parity.

RAID 5 A disk subsystem architecture that stripes data in sector-size blocks; parity is interleaved.

rebuilding Re-creation of data that was lost when a drive failed. The process is also called *reconstruction*.

software array An array that uses control programs (NLMs) and the server's processor to perform array-specific functions, like rebuild parameters.

spindle synchronization A process that coordinates all the disks in an array to use a single drive's spindle synchronization pulse.

striping The equal division of a byte or sector of data across multiple hard disks.

system fault tolerance (SFT) The ability of a system to remain fully operational regardless of component failures.

You can reach the components by removing the side cover of the tower. In the event of a failure, you can remove the disk and power supply on the fly, though this requires more care than in units that allow module swapping. Each disk has a power supply, but there is no redundancy: A failure in one power supply causes a disk to power down and forces a rebuild of that disk even when the data is not bad.

The DAC960 supports RAID Levels 1 and 5 as well as what has come to be called RAID Level 0. It also offers two other proprietary modes, one of which allows the entire hard disk to be accessed as one large disk with no striping or redundancy.

PACKS APLENTY

The basic system comes with a set of DOS-based configuration utilities that allow a great deal of flexibility in setting up the array. These provide a visual representation of the devices and let you designate multiple physical packs of disks consisting of various sizes, RAID levels, and cache policies (write-through or write-back). You can link as many as 20 physical disks by daisy-chaining towers.

Our test unit used DEC's 1.05GB DSP3105 disks. The DAC960 array can handle disks up to 2GB as well as mixed sizes, though it does not use any megabytes beyond what is available in the smallest-capacity disk in the pack.

Rather than replacing a failed disk with a disk housed off-line, you can assign one or more disks to act as on-line spares for one or more physical packs, reducing the fault-tolerance capacity of a single array to 3GB. When we configured the unit to have a hot spare within the physical pack and failed a disk, the missing data was rebuilt to the spare flawlessly.

Optional software sets for NetWare 3.11 and SCO Unix V/386 Release 3.2.4.1 are available. The $345 NetWare kit (used for testing) comes with the needed drivers, a monitoring utility, and a system administration utility that notifies the system administrator's screen. The status monitor graphically represents, in real time, the system's rebuild status (if any), I/O operations per second, and transfer rate. The DAC960 offers no configurable rebuild parameters but was competitive on our Rebuild tests. A rebuild took 10 minutes 42 seconds with no load; on our Rebuild test under load it took 37 minutes 31 seconds.

PC MAGAZINE EDITORS' CHOICE

FACT FILE

Mylex DAC960 Disk Array Subsystem

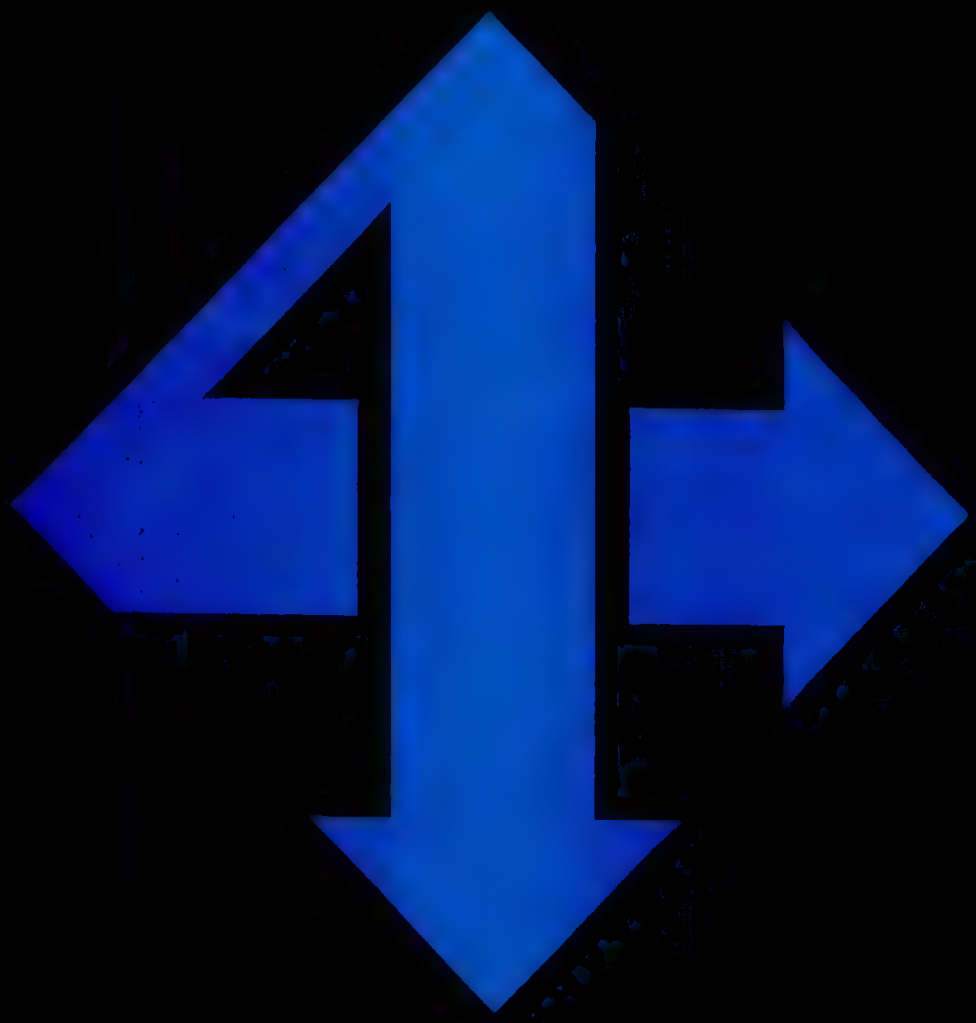
Mylex Corp., 34551 Ardenwood Blvd., Fremont, CA 94555-3607; 800-776-9539; 510-796-6100; fax, 510-745-8016

List Price: $20,000 for 4GB fault-tolerant system including five DEC DSP3105 1.05GB drives, Mylex controller, cables, DOS configuration utility.

Options: NetWare package, $345.

In Short: A top contender, the DAC960 puts the SCSI caching host adapter, a RISC-based array processor, and 16MB of cache RAM on the same board. Offering a high degree of performance and flexibility, it led the pack on almost every test but slowed down greatly with one failed drive. It was also the only product we saw that lets you assign one or more hard disks to act as on-line hot spares.

470 ON READER SERVICE CARD



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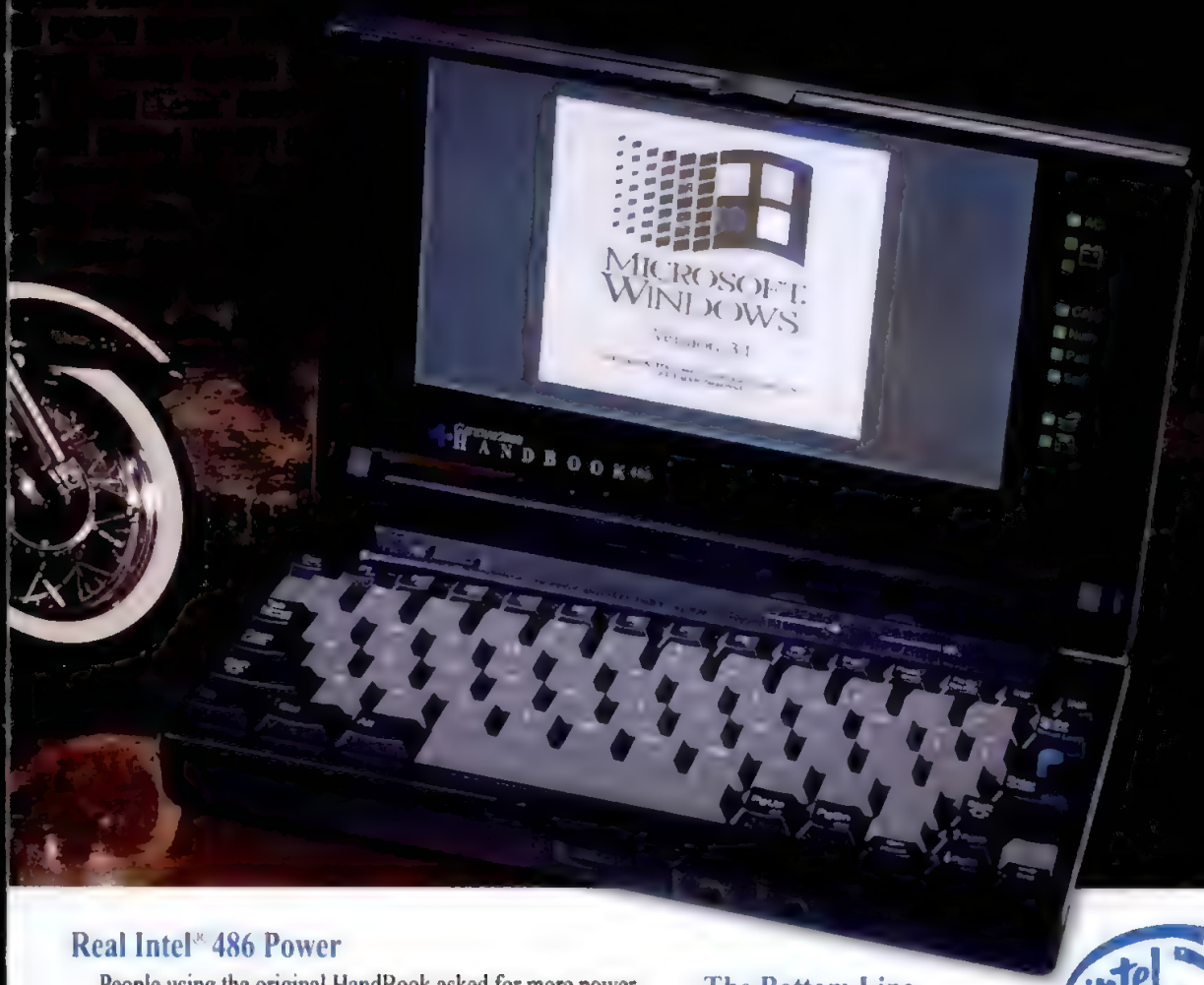

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Backlit VGA, Built-In Pointer, PCMCIA

Users asked for VGA. The new HandBook's screen is a black-and-white VGA display, backlit for use in any lighting situation. No need to carry a mouse with your HandBook 486. The built-in pointing device is convenient and easy-to-use. The HandBook 486 also includes one PCMCIA Type II slot, and the card fits entirely within the footprint of the HandBook.

The Bottom Line

intel inside

HandBook 486 models start at only $1,495, an extraordinary value even by Gateway's standards — and we wrote the book on value! We have a reputation for offering the best prices on high-quality products with exceptional service from friendly folks in the Midwest. Give us a call. Once you get your hands on a HandBook, you'll wonder how you ever lived without one!

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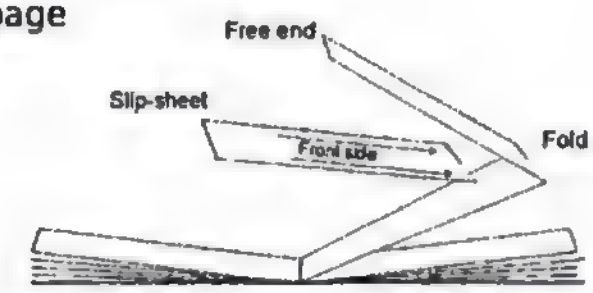

Inverted Foldout slip-sheet

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GbsFlipBack-001B

Back

1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side

Your Hawg, Your Dog, And

"You'll have to pry my cold, dead fingers off to get it away from me." That's what an editor told us once about the Gateway 2000™ HandBook we sent him for evaluation.

A journalist covering the conflict in Somalia called to tell us his HandBook was so popular among his colleagues that he could sell dozens of them for us.

Another user wrote, "The HandBook has changed my life in a way that only a few other products ever have. I take it everywhere with me — something I never did with other notebooks."

This is a tiny sampling of the response to the original HandBook. Clearly, the HandBook — the pioneer product in an entirely new category dubbed "subnotebook" computers — inspired the kind of loyalty usually reserved for Harley-Davidson® motorcycles and man's best friend.

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Now we are proud to introduce the next generation of the HandBook — the HandBook 486. Since we began marketing the original HandBook a little over a year ago, we've been asking customers to finish this statement: "I'd like my HandBook better if _____." The HandBook 486 includes most everything anybody asked for while retaining all the things people love.

The HandBook 486 still weighs under three pounds and is smaller than the day planners many people carry. The new HandBook still has a great keyboard, excellent battery life, a backlit screen, and that wonderful HandBook suspend/resume feature. But the new HandBook has some important features the original didn't have.

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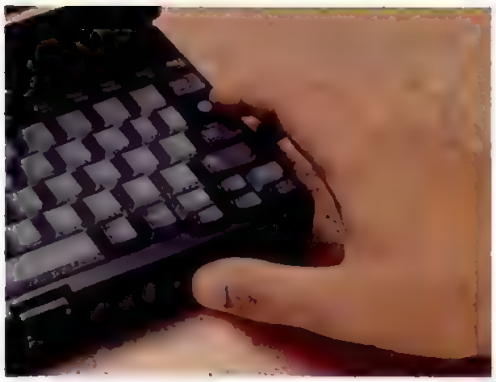

The HandBook 486 has a handy, integrated pointing device.

Even though the HandBook is very small, it has an excellent, touch-type keyboard. You'll also appreciate the sturdy, heavy-duty plastics used in the case.

Options: PCMCIA fax/modem cards, PCMCIA VGA card, PCMCIA network cards, external floppy drive, 4MB or 16MB RAM upgrades, alkaline battery pack, carrying case and extra NiMH batteries. Call for details.

Features

Size

The difference between a 3-pound portable and a 4-pound portable doesn't sound like very much until you lug one around for hours. Then every ounce counts! HandBook users swear by the size of this product. It's big enough to be fully functional, but small enough to take anywhere effortlessly.

Intel® 486SX or DX2 Processor

Your HandBook 486 includes a genuine 32-bit Intel 486 processor — not some chip that's *almost* a 486. Those who crunch numbers will love the high-performance numeric coprocessor in the DX2.

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The HandBook's VGA display is easy on your eyes. The screen is backlit for use in all lighting situations so you won't ever be left in the dark.

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A PCMCIA slot is a great way to add a modem, network card or any of dozens of available PCMCIA-compatible peripherals.

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- 80MB IDE Hard Drive
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- NiMH Battery & AC Pack
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- 1 PCMCIA Type II Slot
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- Parallel, Serial & PS/2 Ports
- MS-DOS,® Windows,™ Interlink and Serial Download Cable

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- 130MB IDE Hard Drive
- 7.9" Backlit VGA Display
- NiMH Battery & AC Pack
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SUMMARY OF FEATURES

RAID Systems

Listed in alphabetical order by company

■ = YES □ = NO

	Ciprico NetArray NA6713-04	Mylex DAC960 Disk Array Subsystem (PC MAGAZINE)	NCR 6298 Disk Array Subsystem Model 1400	Storage Dimensions LANStor Continua Disk Array (PC MAGAZINE)	Storage Solutions SSI RACa-ray 5000 CM-01	Unbound RaidSTOR-T3
List price (tested configuration)	$37,995	$20,345	$66,686	$23,945	$27,995	$15,800 (without host interface)
Dimensions (HWD, inches)	25 x 9.2 x 22	30.5 x 13 x 22	29 x 12.5 x 28	7 x 17 x 22	18.2 x 8 x 14.5	17.2 x 10.5 x 17.5
Weight (pounds)	80	72	209	76	65	62
Number of fans	3	5	3	3	7	2
Supplements NetWare error logs	■	■	■	■	■	□
Supports Raid Level 3	■	□	□	□	■	□
Supports Raid Level 5	□	■	■	■	■	■
Dedicated array processor	Intel 80186/20	Intel 80960/25, Risc	Motorola 68020/25	Motorola 68020/25	Motorola 68020/25	Intel 80960/25, Risc
Cache (tested configuration):						
Hard disk	256K per drive	None	None	512K per drive	512K per drive	None
Array controller	None	16MB*	None	1MB	None	None
Supports spindle synchronization	■	□	■	□	■ (in RAID 3)	□
Drive Specifications						
Hard disk sizes supported	3.5-inch	3.5-inch, 5.25-inch	3.5-inch	3.5-inch	3.5-inch	3.5-inch
Number of drives in tested configuration	9	5	20	5	5	5
Fault-tolerant storage capacity	8GB	4GB	4GB	4GB	4GB	4GB
Supports hot-spare drive	□	■**	□	□	□	□
Supports larger replacement disks	■	■	□	□	□	□
Disks from different manufacturers	■	■	□	□	□	□
Disk rebuild options:						
Dedicated mode	■	□	■	■	□	■
Background mode	■	■	■	■	■	■
Interleaved with user requests	■	■	■	■	■	■
SCSI Host						
Interface	8-bit	8-bit, 16-bit Optional	32-bit	16-bit	32-bit	N/A
Interface type	Fast SCSI	Fast SCSI	Fast-Wide SCSI	Fast SCSI	Fast SCSI	N/A
Bus support	EISA	EISA	MCA	EISA	EISA	N/A
Power Supplies						
Redundant power supplies	■	□	■	■	■	□
Power supply for each drive	□	■	□	□	■	■
Hot-swappable power supplies	□	□	■	■	■	■
Other Platforms						
Microsoft LAN Manager	■	□	□	□	■	■
OS/2	■	■	□	□	■	■
Unix	■	■	■	□	■	■
VINES	■	□	□	□	□	■
Customer Support						
Distribution channels						
Direct distribution	□	□	■	□	■	□
VAR	■	■	■	■	■	■
Toll-free technical support	■	■	■	□	■	■
Support hours (eastern time)	7:00–4:00 M–F	10:00–5:00 M–F	24–hours, 7–days	10:00–8:00 M–F	8:00–7.00 M–F	5:00 A.M.–2:00 P.M. M–F
24-hour BBS	■	■	■	■	■	■
Free on-site installation	□	□	■	□	■	□
Warranty (years)	Drives, 5; adapter, 3; array controller, 1	Drives, 5; system, 1	1	2	Drives, 5; system, 3	1

N/A—Not applicable. Unbound does not sell a host interface, although it supplied one for testing.
*Array controller and SCSI host adapter are a combined unit. **Dedicating an existing drive as a hot spare reduces fault-tolerant storage capacity to 3GB.

The DAC960 did very well on almost all of our performance tests, turning in throughputs well above those of other units. The DAC960, with its 16MB cache, has an NLM that helps to avoid any type of cache conflict with NetWare's own cache. On the Sequential Write test, the DAC960 took first place with a score of 173.2 kilobytes per second. Its Sequential Read score of 603.7 KBps and Random Write score of 53.3 KBps also put the DAC960 at the top in performance. With a failed drive, however, its Random Write score dropped precipitously. This indicates that the dynamic rebuild parameters, preset by Mylex, allocate more network resources to disk rebuild time than to disk performance during rebuild.

The well-designed Mylex DAC960 Disk Array Subystem is a high performer with a great deal of flexibility. Its ability to customize subsections of connected arrays with various access methods makes it suitable for environments where diverse storage requirements exist. And it is a fine contender in almost any situation where response times are key.

NCR Corp.

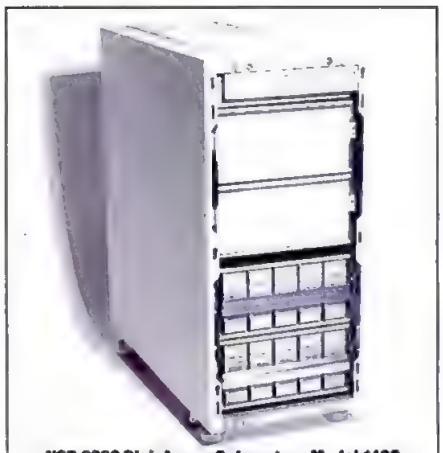
NCR 6298 Disk Array Subsystem Model 1400

BY STEPHEN W. PLAIN

Our first impressions of the NCR 6298 Disk Array Sybsystem Model 1400, gathered as we cleared a path in PC Labs large enough to wheel it through, turned out to be entirely accurate. This heavy-duty system is built to minicomputer standards of hardware design and is engineered for the greatest degree of redundancy and continuous operation.

Unlike the other units we tested for this overview, the NCR array is designed primarily for Unix (though it works readily in a NetWare environment) and requires an MCA host server. It also comes with a list price that will take a bite out of your budget: $66,686 for a 4GB fault-tolerant system.

Standing at 29 by 12.5 by 28 inches and weighing 209 pounds, the NCR 6298 can house up to 20 3.5-inch hot-swappable disks, six power supplies, and four array controllers in one enclosure. The unit's array controller incorporates a 25-MHz Motorola 68020 chip; a 32-bit Fast-Wide NCR K900 SCSI host adapter is also included.



NCR 6298 Disk Array Subsystem Model 1400

Each five-disk row is called a *rank*. RAID Levels 1 and 5 are supported, as is RAID Level 0. Multiple RAID levels can be configured within the same system

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Date of birth : Dec., 1981
Attribute : Monitor Specialist
Legal Position : Company stocks were listed in the centralized trading market in Taiwan, R.O.C.
Certificate : ISO 9002 Certificate No.93/1647
Achievements :
- Top 3 for both annual sales revenue & production output among monitor manufacturers in Taiwan for 1991 (data source:MIC)
- Top 3 on sales revenue among information product manufacturers in Taiwan for 1992 (data source:PC WEEK)
- Top 6 brand distributor, the only one from Taiwan, for PC Monitor Shipments in U.S.A. for 1992 (data source:Stanford Resources, Inc.)
- Top 1 on major supplier share for Multi-frequency Monitor in U.S.A. at the last quarter of 1992 (data source:Stanford Resources, Inc.)

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Scan Frequency	H:30-38KHz 47-50KHz V:50-90Hz	H:30-50KHz V:50-90Hz	H:30-60KHz V:50-90Hz	H:30-60KHz V:50-90Hz	H:30-65KHz V:50-90Hz	H:30-85KHz V:50-90Hz	H:31.25-43.4KHz V:59-90Hz
Resolution	800x600/72Hz 1024x768/60Hz	800x600/72Hz 1024x768/60Hz	1024x768/70Hz	1024x768/70Hz	1024x768/70Hz 1280x1024/60Hz	1280x1024(NI)	640x480/60Hz
Flicker Free	800x600/72Hz	800x600/72Hz	Yes	Yes	Yes	Yes	Yes
Low Radiation	Optional	Optional	Optional	Optional	Yes	Yes	Non Radiation
Full Screen	Non	Yes	Yes	Yes	Yes	Yes	Yes
Digital	Non	Non	Non	Option (1560)	Yes	Yes	Yes

*Model 1785LR will be available in Nov.,1993

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CIRCLE 329 ON READER SERVICE CARD

for simultaneous operation.

Replacement disks, sold by NCR, come in 236MB (as in the test configuration), 426MB, and 1.05GB formatted capacities; however, the replacement must match the size of the original disk. A unit with 20 1.05GB drives (and one array controller) lists for $107,265. Chaining the arrays lets you access up to 140 physical disks.

The redundant power supplies balance the system's load equally. However, to ensure that you have enough power for continuous operation in case of a single-supply failure, you may want to add an extra power supply. The power supplies are hot-swappable.

A similar flexibility exists with the array controller boards: You can assign one controller to one or more ranks of disks (up to 20 disks per controller) or, in Unix configurations only, you can set up redundant array controllers—a feature not commonly found in RAID systems. NCR is currently developing an implementation of this for NetWare.

RAID MANAGER

All the configuring of the 6298 is done through RAID Manager, an NLM that allows you to set up, monitor, and test the array. As with other RAID systems, the 6298 shows you the status of the disks with a matrix representation. However, going beyond merely reporting the normal status levels and detecting disks that are failing, RAID Manager also detects disk mismatches (improper drive models and sizes). Data reconstruction after a disk failure can be controlled by parameters that dictate how the rebuild should be interleaved with network activity.

RAID Manager can set up an automatic parity check and repair process once a day. Any parity errors are reported and, optionally, parity is restored. While this process will fix any errors in the parity, be aware that a failed data block will result in parity being adjusted to the corrupt data.

The unit we received for testing was configured with 20 Seagate 236MB disks. Since the 6298 has a limitation of 10 disks per addressable RAID unit, we set each rank of disks up as a RAID 5 unit, with each rank representing 1GB.

Because of various factors, you cannot directly compare the performance of the 6298 with the other 4GB units; these fac-

FACT FILE

NCR 6298 Disk Array Subsystem Model 1400

NCR Corp., Peripheral Products Division, 3718 North Rock Rd., Wichita, KS 67226-1397; phone/fax: local NCR sales office

List price: $66,686 for 4GB system including 6298-1400 Disk Array Subsystem, 20 Seagate 236MB drives, NCR K900 host adapter, cable, NetWare 3.11 drivers, NetWare RAID Manager/config utility, Generic Array Tool Set for DOS, ADP-37-02 NetWare Disk Driver.

Options: 2.13GB five-drive upgrade, $23,100; 5.25GB five-drive upgrade, $25,950; redundant power supply, $2,225; additional disk array controller, $4,189.

In short: A high-end RAID implementation primarily for MCA-based Unix servers, the 6298 works readily with NetWare and offers high-quality data protection

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BEST OF COMDEX FALL 92 Winner

ModeSwitch, via a hot-key, enables on-the-fly switching between different resolutions without having to restart Windows.

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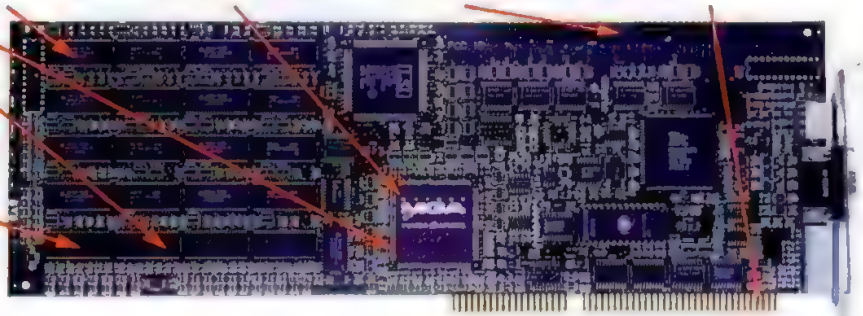
MGA eliminates the bottleneck typical of standard 32-bit graphics chips by giving you twice the data path (64-bits) to process your graphically intensive applications faster.

Capture or run live video-in-a-window with Matrox Marvel or accelerate video playback such as INTEL's INDEO with the power of MGA's 64-bit graphics engine.

MGA accelerators are available for all popular PC architectures, including AT, IBM PS/2 Micro-Channel (MCA), and VESA VL local bus and coming soon, PCI.

A 2 or 4 Mbyte DRAM Z-buffer option gives you hardware accelerated real-time 3D rendered shading at resolutions up to 1280 x 1024.

MGA allows you to manipulate your 2D and 3D drawings in real-time and instantaneously render wire frame drawings to Gouraud shading.



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CIRCLE 124 ON READER SERVICE CARD

tors include an MCA host, the array's use of a greater number of disks than in any other system (which reduces the amount of data that must be written to each drive), and our dividing the system into four separate 1GB arrays (using smaller-capacity disks than in the other systems).

The NCR unit produced throughput scores of 309.1 kilobytes per second on the Sequential Read test and 50.5 KBps on the Sequential Write test. Its score on the Random Read test was 82.3 KBps; on the Random Write test, it was 52.5 KBps. On our Rebuild test without a load, the unit rebuilt a 1GB drive in 3 minutes 36 seconds; the Rebuild test under load took 20 minutes 33 seconds.

The NCR 6298 comes with free on-site installation and 12 months of free on-site service. It is sold primarily with NCR's System 3000 line of Unix-based systems, and less than 5 percent of the installed base exists in a NetWare configuration. The NCR 6298 is superbly designed and represents a glimpse of how RAID is implemented with minicomputer and mainframes. But its high price and NCR's low priority on NetWare may make many NetWare users hesitant about choosing this option at this point.

Storage Dimensions

LANStor Continua Disk Array

BY STEPHEN W. PLAIN

The LANStor Continua Disk Array, from Storage Dimensions, is built exclusively for use with Novell NetWare 3.11. The LANStor lists for $18,315, $23,945, and $31,620 for 2, 4, and 6.4 gigabytes of fault-tolerant storage, respectively. If your storage requirements are strictly NetWare oriented, this unit offers a simple and reliable solution.

The LANStor is Storage Dimensions' first RAID-specific disk subsystem; it supports RAID Levels 5 and 0. The array controller, licensed from NCR Corp., is based on a 25-MHz Motorola 68020 processor and uses five NCR SCSI controller chips to access each drive by means of a separate Fast SCSI-2 channel. The array controller also contains 1MB of cache RAM, but because of its size the cache has little effect on performance. The test unit shipped with a 16-bit Fast SCSI EISA adapter licensed from BusLogic.

A desktop unit that measures 7 by 17 by 22 inches, the LANStor is relatively compact. It houses five drive modules and a dummy drive bay to hold one off-line spare module. A $160 optional kit lets you rack-mount the device. Each drive is contained in a metal housing that slides securely into the cabinet. A locking, flip-down front panel prevents tampering. The cabling is clean and simple.

Among the LANStor's nicest hardware features are its two redundant, hot-swappable, load-balancing power supplies. Since they're accessible from the rear of the cabinet, you can replace a failed power supply without interrupting the operation of the array. A half-turn on three screws is all it takes to release one, making it as simple to replace as a drive. Four guide rails on each power supply module make accidental shorts or jams virtually impossible.

The unit we tested had a fault-tolerant capacity of 4GB and contained Seagate ST11200N 1GB SCSI disks. You can chain up to 4 arrays, or 20 disks. Replacement disks must be the same size as the original and from the same manufacturer, and you must purchase them from Storage Dimensions (the company modifies the firmware on the drives). Buying a spare drive up front adds $2,805 to the purchase price for an additional 1GB drive module. You can, of course, swap disks without bringing the unit off-line.

The software that comes with the LANStor consists of a series of NLMs that use the same bar-menu approach as do many of NetWare's utilities. A separate NLM for rebuilding data after a failure lets you customize the parameters for the rebuild process; the software notifies the system administrator when a failure occurs. You can specify how many blocks of data the system should reconstruct before it pauses to service network user requests, as well as the length of time it spends handling user requests before it returns to the reconstruction process. On our performance tests, the LANStor turned in some of the best rebuild times with and without network activity. On our Rebuild test with no load, it took 6 minutes 54 seconds to rebuild a 1GB drive; on our Rebuild test under load, it took 24 minutes 22 seconds.

On our throughput tests, however, the LANStor turned in some of the lowest scores. It placed last on the Sequential and Random Read tests and close to last on the Random Write test.

According to Storage Dimensions, these low scores can be attributed in part to a bottleneck at the array controller. As we went to press, however, we learned that Storage Dimensions had rectified this situation with driver revisions that implement SCSI command queuing. Storage Dimensions claims that this and other changes will double or triple performance. To improve the array's response time, an option to service read requests before write requests is available (and active by de-

Storage Dimensions LANStor Continua Disk Array

PC EDITORS' CHOICE

FACT FILE

Storage Dimensions
LANStor Continua Disk Array
Storage Dimensions, 1656 McCarthy Blvd., Milpitas, CA 95035; 408-954-0710; fax, 408-944-1200

List price: $23,945 for 4GB system including cabinet, five 1GB Seagate ST11200N drives, cables, EISA host adapter, NetWare 3.11 drivers, utility NLM, LAPIS driver NLM, Array Manager software.

Options: 2GB unit, $18,315; 6.4GB unit, $31,620, MCA kit, $1,390, ISA kit, $1,130; 525MB module, $1,980, 1GB module, $2,805

In short: A well-built desktop RAID 5 array designed for integration with NetWare, the LANStor was slow on throughput but rebuilds with ease and speed and offers a high degree of control over data reconstruction

472 ON READER SERVICE CARD

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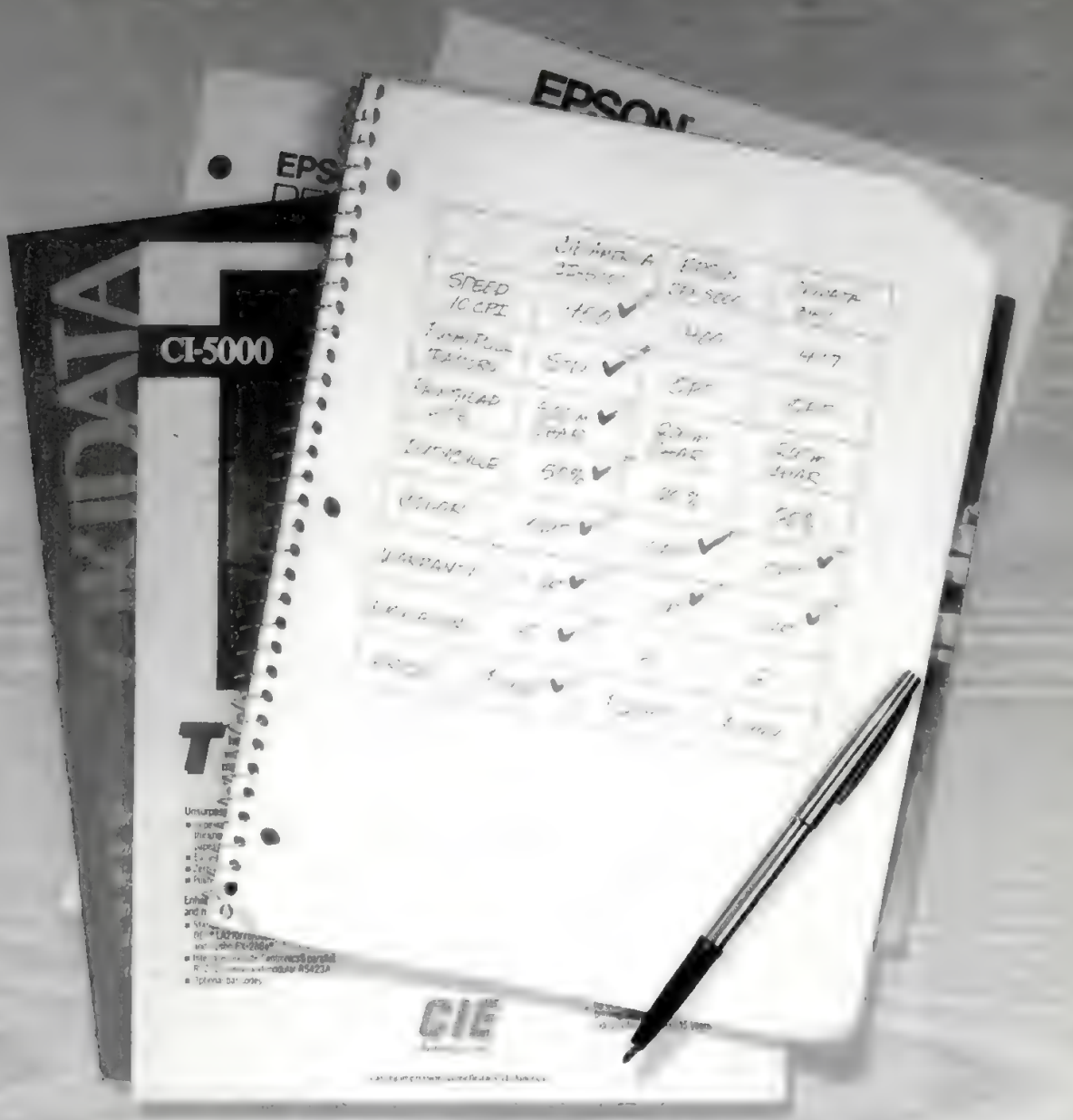

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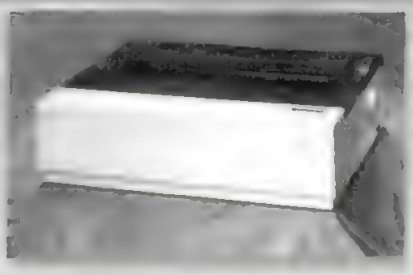

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CIRCLE 336 ON READER SERVICE CARD

fault); there is also a "fusion" option that combines multiple NetWare requests at the array controller to issue one single large request to the physical media.

The LANStor is very well integrated with NetWare, and setup and operation are very simple. It was the only unit in this review group that didn't require technical support on setup or use.

Storage Dimensions is part of Novell's Technical Support Alliance Program, which means that both companies share information about their products among their technical support staffs. If a careful evaluation of your needs shows that the LANStor is sufficient in terms of performance and capacity, it should be an excellent choice for a NetWare LAN.

Storage Solutions Inc.

SSI RACa-ray 5000 CM-01

BY BRUCE BROWN

With its RACa-ray 5000 CM-01, Storage Solutions aims for protection. In addition to SSI's strong technical support (5 years of free on-site service and free installation if desired), the RACa-ray unit comes with a DAT drive for making backups and has a total of seven fans to keep the system running cool. In its 4GB test configuration, the SSI array lists for $27,995, including the drive rack with five 3.5-inch SSI-labeled 1000D 1GB hard disks and the single 8GB SSI DATa-bak8 DAT drive.

The price includes a DPT 2012B Fast-SCSI 32-bit EISA host adapter, the SCSI cable, and a terminator. The control module holds an array controller that has a 25-MHz Motorola 68020 processor. Although the tested configuration came without a cache, you can install as much as 8MB of cache RAM on the array controller. You also get SSI's RAID Monitoring and Management software.

SSI RACa-ray 5000 CM-01

The RACa-ray drive rack holds six proprietary drive units per rank, one of which must be the 8GB DAT drive. However, you can have up to three ranks per array. The inclusion of the DAT drive underlines the need for backups even in a fault-tolerant environment and provides the means for making backups—an extra benefit to users interested in keeping their data safe as well as continuously available.

The vertical configuration rack has six shelves, each with a slight lip on the front. To install a disk you push the drive module in and then press it down to lock it in place; drive removal is easily done by lifting up on the drive module front and pulling. There is no lock or front cover, however, so there is no deterrent to the unauthorized removal of a disk. The 3.5-inch replacement disks, which are available only from SSI, must be identical in size and make to the originals. An upcoming CM-02 model (due out later this year) will support different-size disks as replacements.

Each disk in the SSI array has its own fan, and there is a separate fan for the control module controller board. The SSI unit has separate power supplies for each storage device (so a disk will go down if its power supply does), but it does have a redundant load-balancing power supply setup for the controller board. The RACa-ray lets you hot swap both the hard disk and the power supply.

The SSI system wasn't difficult to set up, although the documentation set was poor (however, the manuals for the DPT controller and the DAT drive included with the set were excellent). The only notable shortcoming is that once the system is booted, it takes 2 to 3 minutes for the controller to bring the whole array system up. This time delay is not documented anywhere, nor is there any special message on the network monitor to indicate that all is well but just not ready yet.

You can configure the SSI RACa-ray for RAID 3, 5, or 0 (though not for multiple RAID levels at one time). For testing, we set the unit to RAID Level 5. Compared with the rest of the 4GB, EISA-based group, the RACa-ray achieved mostly midlevel scores on both the Sequential and the Random Read and Write tests. But with one failed drive, its Random Write throughput scores dropped by a full 40 percent.

FACT FILE

SSI RACa-ray 5000 CM-01

Storage Solutions Inc., 550 West Ave., Stamford, CT 06902; 800-745-5508; 203-335-0035; fax, 203-327-4675

List price: $27,995 including five SSI 1000D 1GB disk drives, one 8GB DATa-bak8 DAT drive, DPT 2012B SCSI adapter, SCSI cable, terminator, DPT NetWare 3.11 disk driver 1.8, SSI RAID Monitoring and Management Software V.3.01

Options: Same configuration with five 1.6GB drives, $35,495, with five 2GB drives, $39,995

In short: An average performer (although its Random Write score dropped significantly with one failed drive), the SSI RACa-ray 5000 CM-01 emphasizes safety: It comes standard with an 8GB DAT tape backup unit and has seven fans to keep things running cool. It also includes extensive levels of user support.

473 ON READER SERVICE CARD

After a drive failure, the drive rebuild process is configured and started via the system monitoring software. You can select time slices and block sizes to favor the most rapid drive reconstruction or the best user response. (As with any setup, the network requires a certain minor percentage of the resources to maintain contact with the nodes, but otherwise you can allocate any amount of the clock cycle toward the rebuild.)

In our testing, rebuilding a failed drive with no load took 22 minutes 21 seconds with the RACa-ray set for fast rebuild; our Rebuild test under load took 1 hour 22 minutes 8 seconds. Both times were the longest of the tested systems.

You can chain up to seven RACa-rays, attached by cable to the SCSI port of each array, for a total physical drive capacity of 35 drives. With seven chained 4GB arrays, you can have 28GB of storage. SSI also sells two other fault-tolerant capacities in configurations otherwise identical to the test model. A 6.4GB ver-

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sion lists for $35,495 and an 8GB array retails for $39,995; both of these units were not available in time for testing.

SSI's strong technical support and service policies (including a special 24-hour support line) and the unit's DAT drive help make this unit a safe choice. If you aren't concerned about top-notch performance and want a flexible system with much better than average technical support, the SSI system bears examination.

Unbound Inc.

Unbound RaidSTOR-T3

BY BRUCE BROWN

Although adding a drive array is never an inexpensive proposition, Unbound's RaidSTOR-T3 is a relatively low-cost solution. In a mini-tower configuration with 4GB of fault-tolerant storage capacity, the RaidSTOR-T3 comes with five 1GB Quantum ProDrive 1225S disks and lists for $15,800. Along with the lowest price of all the units reviewed here, the RaidSTOR-T3 features upgradability through flash EPROM firmware.

While the list price includes the disks and a SCSI terminator, it does not include a host adapter or a SCSI cable, nor does Unbound sell them. In our test unit, however, Unbound had installed a 16-bit Fast-Wide Adaptec 1740A EISA SCSI controller. All the necessary instructions, such as configuring the RAID level and rebuild process, are built into the array controller's flash EPROM.

The RaidSTOR-T3's array controller uses a 25-MHz Intel 80960 CA RISC processor. Five separate SCSI channels for five hard disks are provided. Compatible with SCSI-2 host adapters, the Unbound array controller supports both Wide and Fast SCSI disks. You can configure the unit as a RAID Level 5 (as tested) or as a RAID Level 0 device. You can chain up to 7 arrays, which enables you to access up to 35 physical drives.

Installing the RaidSTOR-T3 device to work with NetWare is simple: No NLMs are needed, and the only drivers involved are the ones that already come with the SCSI adapter card installed in the host system. To NetWare or any other network operating system, the RaidSTOR appears as one big SCSI device. Since the setup does not use NetWare NLMs, however, it cannot perform such functions as carving the disk into separate logical drives, an option found in other systems.

One difficulty turned up during testing: After we configured and installed the unit, we intentionally failed and reformatted a disk, but then could not rebuild the disk without making the RAID unit hang. Eventually, Unbound's technical support staff declared the drive defective and sent us a replacement disk that performed and rebuilt flawlessly. Nonetheless, it was disconcerting to find that the RaidSTOR-T3's firmware did not alert us to the presence of a defective disk during installation. Unbound was unable to explain why this problem occurred.

Unbound RaidSTOR-T3

DISKS AND POWER

Currently the RaidSTOR supports only 3.5-inch 1GB size disks, though a separate unit handles 5.25-inch disks. If a disk fails and must be replaced, only identical model disks can be used; they are available both from Unbound and from third parties. A future version of the Unbound firmware, which will be upgradable through this unit's flash EPROM and should be shipping by the time you read this, is expected to lessen the unit's dependence on one specific disk.

When a disk fails, an alarm sounds and notification is automatically sent both to the unit's 20-character, 4-line LCD panel and to a printer. Unless a device is attached to the array's serial port, however, no error log is maintained. You can unplug and replace a failed disk while the system is running. The RaidSTOR-T3's disks and control keypad are locked behind a front-panel door.

There are separate power supplies for each of the five disks and for the array controller. Just as a failed disk can be hot-swapped, so can a failed hard disk power supply. There is no redundant power supply for the array controller card, however.

Rebuilding a failed disk can be performed in dedicated mode or interleaved with network user requests; both the array CPU clock beat frequency and the number of blocks per beat can be set via the control panel or firmware. In rebuild testing, it took a quick 10 minutes 50 seconds to rebuild a failed disk in dedicated mode and 46 minutes 23 seconds to rebuild the disk fully when the system was set for optimal user response.

The RaidSTOR-T3 did a good job on the 1K block Sequential Read test (319,042 bytes per second) but scored relatively low when it was compared with other systems on the Sequential Write and Random Read and Write tests.

The RaidSTOR-T3's low price brings with it the advantages of upgradability through flash EPROM and easy installation. But its tepid performance and questionable defective-disk detection suggest caution before you decide solely on the basis of price. □

FACT FILE

Unbound RaidSTOR-T3
Unbound Inc., 17951 Lyons Circle, Huntington Beach, CA 92647; 800-862-6863, 714-863-1100; fax, 714-843-0627

List price: $15,800 including disk array with five Quantum ProDrive 1225 1GB hard disk, terminator.
Options: Array cache options: 8MB cache, $4,500, 16MB cache, $8,200; 24MB cache, $11,200; 40MB cache, $17,500; 72MB cache, $29,200, differential SCSI, $300, internal modem, $380
In short: The Unbound RaidSTOR-T3 array has some advantages, including the lowest list price of the tested units, upgradable firmware, and easy installation. But its performance is on the low end, and its inability to detect a defective disk during installation is cause for some concern.
474 ON READER SERVICE CARD

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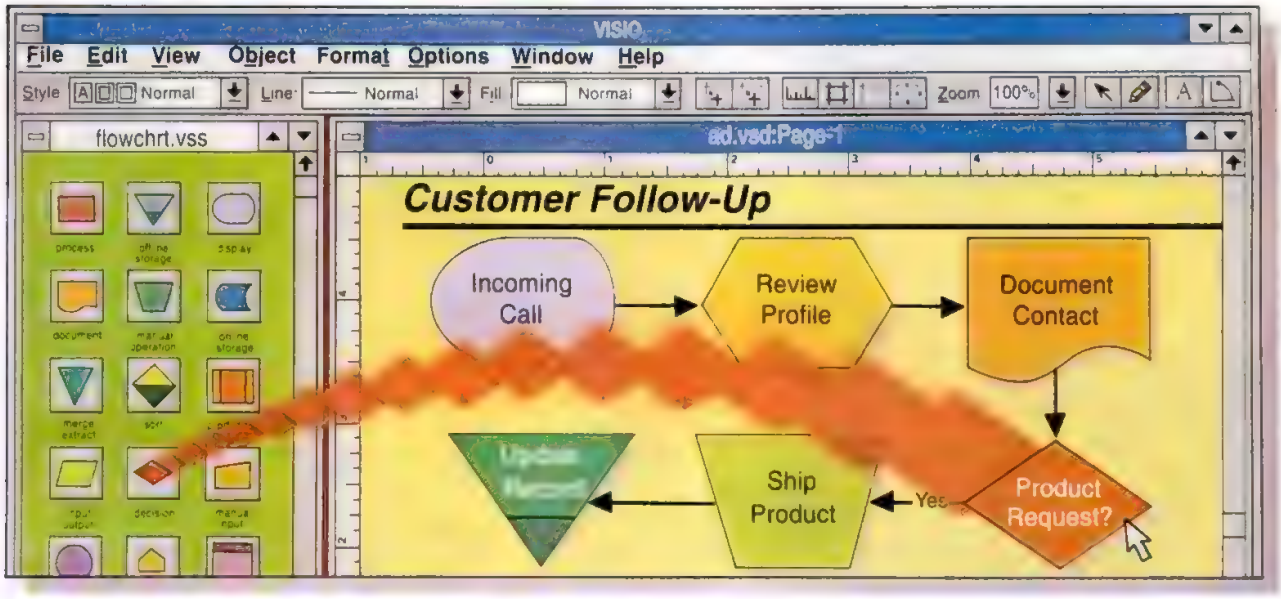

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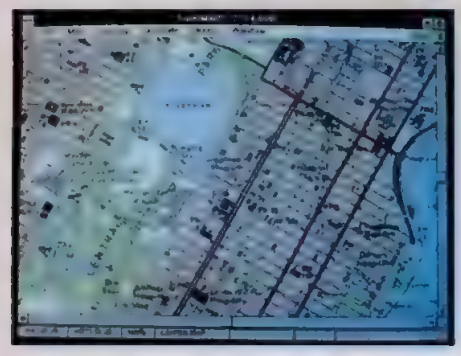

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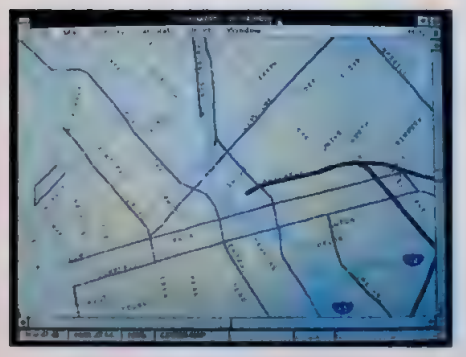

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CIRCLE 327 ON READER SERVICE CARD

POWER PROTECTION

Keeping Up *with* UPSs

An uninterruptible power supply (UPS) is a critical component for protecting your data from surges, outages, and other power-related problems. We test 29 UPSs designed to keep your network up and running.

You know a bad day is brewing when the lights flicker, your network server hemorrhages, and a host of users scream for files they are not likely to see again. Losing data as a result of a power outage can be a disaster for any user or organization. Yet the penalties of network server power problems are entirely preventable.

A backup power system will isolate your server or entire network from all the vagaries of utility power. In fact, with so much on the line and the cost of protection so small, operating any server without a backup power system of some kind is reckless.

A backup power system supplies electricity to a PC (workstation or server) when the main current fails. It bridges fraction-of-a-second power pauses that inevitably crash systems, and keeps you running during util-

by Winn L. Rosch

Illustration by Tim Lewis

ity outages many minutes long. Properly installed with your network operating system, a backup power system will keep your server operating without interruption until its battery reserves grow weak; it will then warn users to save their work and will smoothly shut down the network so it can be brought back up when reliable power is restored.

REVIEW CRITERIA

Our roundup includes 29 backup power systems that were rated to supply between 600 and 900 va (volt-amperes) of backup power—enough to satisfy the needs of a small network: a server and four PCs. The systems were required to have network signaling capabilities and single-user protection. We also required each device to provide surge suppression, because we felt a backup power system should provide protection from all utility-related power problems.

We limited each manufacturer to one model that was representative of its product line, with two exceptions—American Power Conversion Corp. and Tripp Lite—each of which offers two different product lineups that overlap in our test range. (Tripp Lite owns Unison but retains the Unison name in addition to the Tripp Lite line.)

All the backup power systems we tested had the same basic makeup. Each contained a set of heavy-duty batteries to store power until needed, plus electronic circuitry called an *inverter* to convert the DC (direct current) from the batteries to the AC (alternating current) used by your PC; additional circuitry to keep the battery charged and ready, and circuitry to control the delivery of battery power to your system.

Our Editors' Choices, from SOLA, Deltec Electronics Corp., and Exide Electronics Corp.

Even within our range of power ratings, prices varied widely—from $315 to $1,686 list. Higher-priced units usually contained more features but did not necessarily provide more protection.

13 ACCEPTABLE UNITS

Based on extensive testing at ZD Labs, we concluded that the following 13 units delivered acceptable protection from nearly any power-related problem faced by a PC or network server: Acme's Network Power Processor NPP-800, the American Power Smart-UPS 900, Best Power Technology's Fortress LI 660B, Clar

HIGHLIGHTS

Uninterruptible Power Supplies

WE TESTED 29 uninterruptible power supplies (UPSs) rated at 600 va to 900 va, which is enough power to support a small network—a server and four PCs. The UPSs we tested range in price from $315 to $1,686. Thirteen of the units passed all our tests at ZD Labs and were deemed worthy of recommendation, while 3 of the 13 stood out as Editors' Choices: the Deltec, the Exide, and the SOLA.

UNINTERRUPTIBLE POWER supplies (UPSs) are critical for protecting PC networks from the dangers of a variety of power quirks (surges, spikes, outages, and the like). In addition to providing backup power for outages, we believe that UPSs should provide complete power-line treatment, which would include surge and static discharge suppression.

A UPS MUST BE ABLE to switch from utility to backup battery power within a short enough duration to allow a PC to remain running (PCs crash after power loss of 300 milliseconds, or 0.33 seconds). All of the 29 UPSs we tested were able to switch over in time (the slowest was 12 ms).

UPSs VARY IN FEATURES (indicators, network alerts, voltage regulation, and so forth), duration of backup power, and wave form. A UPS must provide enough backup power to enable users to shut down a PC network gracefully, without data loss. Generally, the more backup protection, the better.

A UPS SHOULD SMOOTH OVER any small line events of short duration (surges, spikes, brief interruptions, and other minor electrical disturbances) as well as serious outages and lightning strikes. Not all the UPSs we tested lived up to their claim of providing surge and static protection. Fourteen units failed our surge tests, and four of the units tested failed our static discharge (shock) tests.

A UPS SHOULD REGULATE the voltage that is supplied to your PC by offsetting any drops or surges and maintaining a steady voltage (117 volts is standard for PCs). While their capabilities and techniques may vary, all of the UPSs in this review provided adequate voltage regulation.

Photograph by Robert Cardin

OnGuard PC-2400, the C-Power VPS-750, Deltec's PowerRite Pro PRA600A, the EPE/Topaz Integrity 800, Exide's Powerware Personal Series Model 800 VA, IntelliPower's Bright UPS IQ 650, the Oneac ON 900, the SOLA Advanced Network Plus UPS, Superior Electric's Stabiline UPSY61008, and Tripp Lite's BC600LAN.

POWER RESERVES

How long a backup power system needs to supply your PC, server, or network with homegrown electricity depends on your business strategy. If all you require from a backup power system is enough time to save your work and shut down your network safely, as little as 5 minutes should be sufficient. All of the units we tested were able to deliver at least 5 minutes of power at 75 percent of their rated loads. If you want to keep working for many hours or days after an outage, you should buy an emergency generator that runs on gasoline or natural gas.

Most users require just enough time to keep trains of thought on track, ensure that network files are not scrambled, and make a rational decision about the prognosis of the outage and the need for shutting down. An inadvertently thrown power switch can be fixed in seconds; hurricanes take longer to abate. Some of these backup power systems will give you more than half an hour of emergency power and thinking time—even more if you demand less than 75 percent of their rated loads.

MORE IS BETTER

We found that the more backup energy that was available (the longer the backup time), the more costly the unit. The one standout was the SOLA unit (one of our three Editors' Choices). Not only was it able to power 75 percent of its rated load longer than any other unit, it also showed the greatest value with the fixed load. In fact, it provided more emergency runtime than a device nearly twice as expensive (Clary's OnGuard, priced at $1,590 versus the SOLA's $798).

PC MAGAZINE ▶ EDITORS' CHOICE

- **Deltec Electronics' PowerRite Pro PRA600A**
- **Exide Electronics' Powerware Personal Series Model 800 VA**
- **SOLA Advanced Network Plus UPS**

Of the 29 UPSs we tested, we deemed 13 worthy of recommendation. Which one is right for you depends on your budget and needs. Of the 13 acceptable performers, three stood out as Editors' Choices—Deltec's PowerRite, Exide's Powerware, and the SOLA. The Editors' Choices were awarded in three categories: best overall price/performance, longest backup operation, and lowest price UPS that delivers full power protection.

Our overall price/performance Editors' Choice winner is the SOLA Advanced Network Plus UPS. The SOLA provides long-lasting backup with complete surge and static protection at an attractive price ($798 list). The SOLA device delivered 100 percent of its rated power for more than 22 minutes, and it was able to provide backup for almost 36 minutes at 75 percent power level.

Our Editors'Choice winner for providing the longest backup operation is the Deltec PowerRite, which lasted for 40 minutes at 75 percent load and outdistanced all of the other units tested.

The Editors' Choice for the lowest priced backup power system that delivers full power protection is the $559 Deltec. Although the Deltec is low-priced, it also had relatively low power reserves, providing only about 13 minutes of backup power at 75 percent load (300 watts) and 4.5 minutes at full capacity.

We also recommend the following 11 UPSs, which we feel can deliver acceptable protection from most PC network power-related problems: the units from Acme, American Power (Smart-UPS 900), Best, C-Power, Clary, EFI, EPE, IntelliPower, Oneac, Superior Electric, and Unison.

The remaining 15 UPSs do not receive a recommendation because they failed our surge or static discharge tests. They include the units from Alpha, American Power (Back-UPS 600), Controlled Power, Golden Pacific, ITT/Constant Power, Kensington, Liebert, Meirick, Minuteman, Network Security, Perma Power, Powercom, Tripp, TSi, and Upsonic.

Traditionally, backup systems have been divided into two classes: true uninterruptible power supplies (UPSs), which deliver a constant current to your PC without the briefest pause (interruption); and standby power supplies (SPSs), which switch from utility to battery power and briefly interrupt their output. This interruption is so short that nearly all PCs ignore it and continue operating as though the electrical supply were continuous.

The term UPS is often used for both uninterruptible and standby devices (Underwriters Laboratories, for example, uses UPS to mean both types of systems). Technology also is smoothing over the differences. At one time, UPSs were double-conversion devices that continuously kept an inverter connected to the PC with the batteries on-line. Utility-supplied electricity (AC) was converted to battery power (DC), which was converted back to AC for the PC. Strictly

Our Contributors: WINN L. ROSCH is a contributing editor to *PC Magazine*. MICHAEL NEUBARTH was the associate editor in charge of this story, and JON HILL was the project leader.

Performance Tests: Uninterruptible Power Supplies

How We Tested

We tested the capacity of each UPS under 75 percent of its rated load, and under a fixed load. Having determined the 75 percent load for each unit, we measured the **Reserve Time** using a test-bed consisting of resistive and switch-mode loads. The test-bed for the fixed load consisted of a network server, three monitors, and two client workstations, with a total load of 369W.

We conducted the **Network** software tests on a network consisting of a file server and four PCs. We set the wait time—the time between loss of power to the UPS and broadcast warnings by the UPS software—to 1 minute. Network shutdown was set to occur 5 minutes after the initial loss of power. The tests included a 30-second blackout, a 2-minute blackout, a 5-minute blackout, and a prolonged blackout. A 30-second blackout should not cause a broadcast warning, nor should the network shutdown begin. The 2-minute blackout should trigger a broadcast warning but not a network shutdown. The 5-minute blackout should trigger both a broadcast warning and a network shutdown; in addition, after the network shutdown occurs, the UPS should shut itself down.

For the prolonged blackout, we set the wait time and network shutdown time beyond the range of the battery life of the units. To achieve a passing grade, the UPS had to recognize that its batteries were beginning to run out of power and begin an orderly shutdown—despite the fact that the network shutdown had not been exceeded.

To determine the **Voltage Variation,** we varied the input voltage to each UPS from 130V to 20V and recorded the output voltage of the UPS. Ideally, the output voltage should remain fixed at 120V. Units that did best in this context showed a combination of average voltages close to 120V and extremely low standard deviations (less than 1V).

The **Surge** tests simulated a lightning strike near the power line. A positive polarity ring wave of magnitude 6,000V, 500A was transmitted from line to neutral, line to ground, and neutral to ground. Each test was run at a 90° phase shift and 270° shift. To pass each test, the UPS had to suppress the large voltage spikes without shutting down.

The **Electrostatic Discharge** tests simulated user contact within an office environment. Each UPS was shocked in 15 places that a typical user might make contact. Because of the range of failed responses, we created a scale of points. A unit that merely emitted an audible alarm received 5 out of a possible 6 points, while a unit that dropped its output voltage and required a manual reset received 1 point.

	BATTERY RESERVE TIME WITH 75% LOAD			NETWORK		VOLTAGE VARIATION		SURGE	ELECTROSTATIC DISCHARGE	
	VA Rating (volt-amperes)	75% Load (watts)	Reserve Time With 75% Load (minutes) ❶	Software Testing*	Reserve Time With Fixed Load (minutes) ❶	Average Output (volts) ❷	Standard Deviation (volts) ❸	Passed Tests (out of 6)	Passed Tests/ Total Tests (out of 15)	TOTAL POINTS (out of 90)**
Acme NPP-800	800	450	10	N/A †	11	119.8	4.9	6	14	87
Alpha CFR 600	600	300	36	4, 6	20	125.6	0.8	6	4	44
American Power Back-UPS	600	300	11	Pass	4	106.3	8.7	5	15	90
American Power Smart-UPS	900	473	13	Pass	16	118.8	5.5	6	15	90
Best Power Fortress LI	600	300	7	4	5	118.6	4.4	6	15	90
Clary OnGuard PC-2400	800	420	20	Pass	21	121.0	0.7	6	15	90
Controlled Power 850	850	450	12	N/A †	16	120.3	0.6	6	0	15
C-Power VPS-750	750	416	17	4	18	120.9	0.5	6	15	90
Deltec PowerRite Pro	600	300	12	Pass	4	119.3	3.7	6	15	90
EFI LanGarde 600	600	361	9	4, 6	5	115.0	5.8	6	14	89
EPE/Topaz Integrity 800	800	420	17	Pass	14	120.0	0.6	6	15	90
Exide Powerware 800 VA	800	394	37	4, 6	38	114.8	0.1	6	15	90
Golden Pacific Abler 600A	600	300	5	2, 3, 4, 5, 6	1	98.2	21.0	0	15	90
IntelliPower Bright 650	650	327	5	3, 4, 5	6	118.4	0.3	6	12	84
ITT/Constant Power SP900	900	473	14	Pass	23	119.4	4.0	5	14	88
Kensington 600	600	360	6	4	7	118.2	5.4	2	15	90
Liebert AccuPower 750	750	400	15	4, 6	13	120.9	0.3	2	15	90
Meinck PowerPro 600SLR	600	360	17	1, 4, 6	14	108.0	8.0	0	15	90
Minuteman PowerMind 600	600	300	11	Pass	5	118.1	4.8	2	15	90
Network Security 800-US	800	480	9	Pass	10	118.2	5.1	2	7	42
Oneac ON 900	900	450	12	Pass	11	103.0	12.2	6	15	90
Perma Power SPS-800L	800	375	5	6	7	118.2	5.3	5	15	90
Powercom UPS-600A	600	301	12	2, 3, 4, 5, 6	6	118.7	4.7	2	12	84
SOLA Advanced Network	600	300	38	Pass	22	111.4	10.2	6	15	90
Superior Electric	800	420	20	Pass	19	120.1	0.7	6	15	90
Tripp BC 600LAN	600	319	17	Pass	13	118.4	7.5	5	10	86
TSI UPS-7200	700	375	9	4, 6	7	N/A ‡	N/A ‡	5	2	64
UniPower PS 6 0	600	300	11	Pass	4	116.2	0.8	6	15	90
Upsonic PC Might 80	800	360	10	Pass	10	124.2	8.4	1	15	90

N/A † —Not applicable The network software was not available when we ran these tests.
N/A ‡ —Not applicable We could not run this test because the unit was damaged in the process of surge testing

❶ Higher scores represent better performance
❷ A score of 117 volts represents optimal performance
❸ Lower scores represent better performance

*** Key:**
1—Failed 30-Second Blackout
2—Failed 2-Minute Blackout
3—Failed 5-Minute Blackout Server Shutdown.
4—Failed 5-Minute Blackout UPS Shutdown
5—Failed Prolonged Blackout Server Shutdown.
6—Failed Prolonged Blackout UPS Shutdown.

**** Scale of points:**
6—Pass.
5—Minimal effect, audible alarm.
4—Brief switchover to inverter; no change in voltage output.
3—Brief loss of voltage output; immediate recovery
2—Brief loss of voltage output; switchover to battery
1—Loss of voltage output; manual reset required

Get a hold of the best value in LAN power protection

Now just $139!* suggested list price

Blackouts, brownouts, sags... Your data and hardware are vulnerable to problems that surge suppressors and power directors are just not equipped to handle.

Now there's a complete Uninterruptible Power Supply solution to suit any budget. The Back-UPS™ 250 is reliable protection for LAN nodes, 386SX machines, 286, small PS/2 systems, and internetworking hardware such as routers, bridges, gateways and repeaters.

From the largest server to the smallest router, the Back-UPS Series will increase your productivity by providing a cost-effective solution to power problems. Call for your free power protection handbook.

The **Back-UPS 250** offers even more cost-effective protection for LAN nodes (typical runtime for a 386SX system is 10 minutes).

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Guaranteed ABSOLUTE™ Protection

- ABSOLUTE™ Protection guarantees repair or replacement of equipment (up to $25,000) if damaged by a surge while protected by a properly installed Back-UPS (See warranty for details).
- UL, CSA and Novell approved with a 2 year warranty
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- Most models include LAN interface for automatic-shutdown of Novell, LAN Manager, LAN Server, LANtastic, Banyan, SCO Unix, and others
- Ask about PowerChute® UPS monitoring software and Novell compatible UPS monitoring boards
- 230V models available

LAN TIMES READERS CHOICE 1992

Reseller News Editors' Choice

1991, 1990

	Model	Application	List	New List
	Back-UPS 250	LAN nodes, 386SX, 286, internet hardware, POS	~~$169~~	$139
	Back-UPS 400	Desktop 386, 486 systems, 286 servers	~~$249~~	$229
	Back-UPS 450	Tower 386, 486 systems, servers	~~$329~~	$279
	Back-UPS 600	Heavily configured systems, CAD/CAM workstations	~~$449~~	$399
NEW!	**Back-UPS 900**	Multiple systems, longer runtime applications		$599
NEW!	**Back-UPS 1250**	Multiple systems, LAN hubs, small minis, telecom equipment		$799

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CIRCLE 162 ON READER SERVICE CARD

THE NEW OL400e: NO LASER PRINTER MEASURES UP TO OUR FEATURES AND DOWN TO OUR SIZE.

(Diagram not actual size, but you get the idea, it's a small printer.)

12.6"

14.2″

THE OKIDATA OL400e LED PAGE PRINTER INTRODUCES A NEW FORM OF BUSINESS ECONOMICS. SPEND LESS. GET MORE. Not only is it small, but the OL400e is loaded with features that you'd normally find only in larger, higher-priced laser printers and has *more* features than you'd have to settle for in ordinary inkjet printers.

Okidata's solid-state printhead delivers laser perfect sharpness with LED reliability. Reliability backed with a five-year printhead warranty, the lengthiest in the industry. Under the OL400e's compact 14.2″x 12.6″case is a built-in 100 sheet paper tray. You can print transparencies, cards, labels, and envelopes, and collate them, too. The OL400e's microfine toner gives every printed character a smoother, cleaner edge. And you can choose your favorite smooth characters from 44 internal fonts–all this at an industry standard 4 pages per minute.

The Okidata OL400e is not only PC-compatible, it's wallet-compatible. So if you've put off buying a printer, and have a square foot or so to spare, telephone 1-800-OKI-TEAM, EXT. 288 for the dealer nearest you. And find out how much more you can get by spending less.

CIRCLE 056 ON READER SERVICE CARD

THE OL400e BY OKIDATA®

a Division of Oki America, Inc.

OKIDATA Reg. T.M. M.D. OKI Electric Industry Company, Ltd.

▶ SUMMARY OF FEATURES

Uninterruptible Power Supplies

Products listed in alphabetical order by company

■ = YES □ = NO

	Acme Electric Corp. **Network Power Processor NPP-800**	Alpha Technologies Inc. **Alpha CFR 600 (w/intelligent interface device)**	American Power Conversion Corp. **American Power Back-UPS 600**	American Power Conversion Corp. **American Power Smart-UPS 900**	Best Power Technology Inc. **Fortress LI 660B**	Clary Corp. **OnGuard PC-2400**
General Features						
List price	$799.00	$1,686.00	$399.00	$899.00	$649.00	$1,590.00
Type	Standby	On-line	Standby	Line-interactive	On-line	On-line
Weight (pounds)	38	60	25	43	28	40
Size (HWD, in inches)	7.6 x 6.9 x 14.3	16.5 x 8.5 x 16.5	6.6 x 4.7 x 14.2	9.1 x 6.9 x 17.8	7 x 5.5 x 16	9.8 x 5.9 x 15.8
Volt-ampere rating	800	600	600	900	660	800
Number of AC outlets	4	4	4	6	4	5
Type of wave output	Pure sine	Pure sine	Modified sine	Pure sine	Pure sine	Pure sine
User-replaceable battery	■	■	□	□	□	■
Extended battery available	□	■	□	□	□	■
Programmable Features						
Remote monitoring	■	■	□	■	■	□
Remote notification	■	■	□	■	■	□
Remote testing	■	■	□	■	□	□
Remote server reboot	■	□	□	■	□	□
Automatic server reboot	■	□	■	■	■	□
Third-party sensing	■	■	□	□	□	■
Adjustable voltage parameters	■	■	■	■	■	■
Inverter shutdown	■	□	■	■	■	■
Multiple-server shutdown	■	□	□	■	■	■
Voltage-irregularities log	■	■	■	■	■	□
Graphical display	□	■	□	■	■	N/A

N/A—Not applicable: The product does not have this feature

speaking, a double-conversion UPS is the purest form of on-line unit.

New technologies have virtually eliminated double-conversion UPSs. Instead, the preferred design is the *on-line* UPS, where both the inverter output and utility power are connected to a line that runs to the PC. No switching is necessary. Thus, the distinction between UPSs and SPSs is no longer meaningful. The short switching times of commercial standby systems are fast enough (by a great margin) to keep any current PC running without interruption.

IBM's early (1982) XTs had safeguard circuitry so sensitive to brief interruptions that a 4-ms power dropout caused by an SPS might shut them down. These 8088-based PCs are effectively obsolete, particularly as servers.

All modern PCs can continue operating despite power interruptions lasting hundreds of ms—several times as long as the dropout of even the slowest of today's SPSs. For example, we found that a Compaq Deskpro 386SX/20 did not crash until an outage lasted about 380 ms, while a Gateway 2000 386SX-20 ran until the power was off for about 333 ms (about 0.33 seconds). Only one of the SPSs we tested had a switching time in excess of 8 ms (half a wave of 60-Hz power): the Oneac, which required 12 ms to switch, still about 30 times as fast as a modern PC requires.

Of the units we evaluated, 12 were traditional standby (switching) designs: Acme's NPP-800, the American Power Back-UPS 600, Deltec's PowerRite Pro PRA600A, Golden Pacific's Abler, Kensington Microware's Power Backer, the Meirick PowerPro, the Network Security, the Perma Power, the Powercom, the Tripp, the TSi, and Upsonic's PC Might 80.

Six vendors used the term *line-interactive* to describe products for which we found measurable (although short) switching times: American Power's Smart-UPS 900, EFI's LanGarde, ITT/Constant Power's Dual Power DP900, the Minuteman, the Oneac, and the SOLA. Except for the Fortress LI 660B, the remaining backup systems were true on-line units with zero switching time. The Fortress, which Best Power Technology described as an on-line system, demonstrated a 2-ms switching time.

SURGE PROTECTION

Besides requiring no switching time, the old double-conversion style UPS provided built-in surge protection. Any dangerous electrical anomalies were erased by the initial conversion. The battery inside the double-conversion UPS, which is always in the path of power flow, acts like a sponge that absorbs spikes, surges, and other transients. As a result, the regenerated AC power delivered by a double-conversion unit is often purer than the power supplied by a utility company.

CONTINUES

ontrolled ower Co. **ontrolled er LT Series ndable UPS odel 850**	C-Power Products Inc. **C-Power VPS-750**	PC MAGAZINE EDITORS' CHOICE Deltec Electronics Corp. **PowerRite Pro PRA600A**	EFI Electronics Corp. **LanGarde 600**	EPE Technologies Inc. **EPE/Topaz Integrity 800**	PC MAGAZINE EDITORS' CHOICE Exide Electronics Corp. **Powerware Personal Series Model 800 VA**	Golden Pacific Electronics Inc. **Abler Miniguard-600A**	IntelliPower Inc. **Bright UPS IQ 650**	ITT/ Constant Power **Dual Power DP900**
1,255 00	$1,255.00	$559.00	$659.95	$1,395.00	$1,199.00	$315.00	$799.00	$999.00
On-line	On-line	Standby	Line-interactive	On-line	On-line	Standby	On-line	Line-interactive
64	57	25	27	39	38	22	29	49
x 8.5 x 17.5	19 6 x 6.3 x 15.3	6.5 x 4.5 x 15.7	6.4 x 7.1 x 14	10 x 6 x 16	13.5 x 5.3 x 12.4	6.3 x 3 7 x 14.1	16 x 3.4 x 17	13 x 6.3 x 15
850	750	600	600	800	800	600	650	900
6	3	4	4	5	6	2	5	4
ure sine	Pure sine	Pure sine	Pure sine	Pure sine	Pure sine	Modified sine	Pure sine	Pure sine
■	■	■	■	□	□	■	■	□
■	■	□	□	■	■	□	■	■
■	□	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■	■
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■	■	□	□	■	□	□	■	□
■	■	■	■	□	■	■	■	□
■	□	■	■	N/A	□	□	■	N/A

Most other on-line and standby technologies offer no intrinsic surge protection (ferro-resonant designs, which incorporate huge reactance via a magnetic coil, can smooth out electrical anomalies). However, manufacturers of commercial units invariably incorporate auxiliary surge protection circuitry in their products, which effectively makes them all-in-one power protection devices.

As with standalone surge suppressors, the protection circuits in standby and on-line backup systems vary in quality. Poorly designed surge suppression circuitry in a backup power system can leave you unprotected.

To ascertain the effectiveness of the protection circuitry inside each backup power system, ZD Labs subjected each unit to an abbreviated test protocol derived from the surge tests used for evaluating suppressors in our issue of April 13, 1993 ("Surge Suppressors: Cutting Surges Down to Size"). As in those tests, each backup power system was jolted with 6,000-volt surges designed to simulate the effect of a lightning strike on the power supply line. The test measured the UPS surge dampening ability.

The results were revealing. Five devices allowed intense surges—intense enough to pose a hazard to computer equipment—to pass through: American Power's Back-UPS 600, ITT/Constant Power's Dual Power, the Perma Power, the Tripp, and the TSi. Seven other devices were worse, allowing four or more surges of intensity harmful to PCs to pass through. Those units, which provide virtually no surge protection at all, included Golden Pacific's Abler, Kensington's Power Backer, Liebert's AccuPower, the Meirick, the Minuteman, the Network Security, and Upsonic's PC Might 80.

STATIC DISCHARGE

We also submitted each UPS to a static discharge test that simulated a high-voltage pulse (like the shock that occurs when you touch an object after walking across a carpet). We gauged static problems of six levels of severity according to how the backup power system reacted—from minor (the jolt caused the system to sound its alarm) to major (the jolt caused physical damage to the system).

Only two responses posed a risk to data: UPSs that shut down and required manual resetting after the static discharge, and UPSs that suffered permanent damage. The Alpha, Controlled Power, and Network Security all required manual resets. Only the TSi was damaged. The other 25 backup power systems we tested shrugged off the static with no outward effect.

VOLTAGE REGULATION

A classic double-conversion UPS isolates your PC from voltage variations on your power line because its output voltage is controlled internally rather than left to

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- One Diskette Drive (3.5" or 5.25")
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- 128KB SRAM Cache
- 8 ISA Expansion Slots
- Upgradeable to Pentium Technology
- Accelerated Local Bus Video with 1MB Video RAM
- UltraScan 15FS Monitor (15", 1024 x 768, .28mm, NI)
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SUMMARY OF FEATURES

Products listed in alphabetical order by company

■ = YES □ = NO

	Kensington Microware Ltd. **Power Backer Plus 600**	Liebert Corp. **AccuPower Gold Model 750**	Meirick Inc. **Meirick PowerPro 600SLR**	Minuteman UPS **Minuteman PowerMind 600**	Network Security Systems Inc. **Network Security IPS/AI 800-US**	Oneac Corp. **Oneac ON 900**
General Features						
List price	$649.95	$1,249.00	$579.00	$579.00	$799.00	$899.00
Type	Standby	On-line	Standby	Line-interactive	Standby	Line-interactive
Weight (pounds)	36	45	45	29	44	69
Size (HWD, in inches)	16.3 x 5.6 x 8.9	9.6 x 7 x 20.3	3.2 x 17 x 13.5	15 x 4 x 8	8.8 x 5.6 x 16.3	12 x 8.3 x 15.3
Volt-ampere rating	600	750	600	600	800	900
Number of AC outlets	6	4	4	4	6	6
Type of wave output	Pure sine	Pure sine	Modified sine	Pure sine	Pure sine	Modified sine
User-replaceable battery	□	□	□	■	■	■
Extended battery available	□	□	□	□	□	□
Programmable Features						
Remote monitoring	□	□	■	■	■	■
Remote notification	□	Optional	■	■	■	■
Remote testing	□	Optional	□	■	■	■
Remote server reboot	□	□	□	□	■	■
Automatic server reboot	□	Optional	□	■	■	■
Third-party sensing	□	□	□	■	□	■
Adjustable voltage parameters	□	□	■	□	■	Optional
Inverter shutdown	□	■	□	■	■	■
Multiple-server shutdown	□	■	□	■	■	■
Voltage-irregularities log	□	■	■	■	■	■
Graphical display	N/A	□	□	■	■	■

N/A—Not applicable: The product does not have this feature

the vagaries of your power company. In fact, should your neighborhood suffer a brownout, a true UPS will deliver the same steady 120 volts that your computer equipment requires.

Other backup technologies differ in their ability to control voltage. Ten of the backup power systems we tested could dynamically regulate voltage and keep their output at the same level a double-conversion UPS would maintain. The units were the Alpha, Clary's OnGuard, the Controlled Power, the C-Power, Liebert's AccuPower, the EPE, Exide's Powerware, IntelliPower's Bright UPS, Superior Electric's Stabiline, and Unison's UniPower. Their output stayed within a range of a few volts when we varied the input from 80 to 130 volts.

Some backup systems regulate in discrete steps by automatically altering transformer taps or similarly compensating for input variations. These allow voltage to drift within a range; should the voltage drift too far afield, the products switch to backup operation. The units demonstrating this trait included Acme's NPP-800, Best's Fortress, Deltec's PowerRite Pro, EFI's LanGarde, Golden Pacific's Abler, the Minuteman, the Oneac, the Powercom, and the SOLA.

The remaining standby power systems controlled their output voltage only after their inverters had switched into operation, affecting control as an all-or-nothing affair. The output voltage from these units can rise or dip dramatically before switchover.

As long as the backup system maintains the voltage within the range that your PC can accommodate, you have nothing to worry about. ZD Labs' tests revealed that PCs could tolerate voltage drops well below the regulation range of any of the backup systems tested. For example, a Compaq Deskpro 386SX/20 shut down at 62.7V, and a Gateway 2000 386SX-25 shut down at 67.2V. None of the backup systems allowed their output voltage to fall below 80V, while only four units (Best's Fortress, the C-Power, the Tripp BC, and the TSi) allowed their output to fall below 95V. In other words, all of the backup power systems we tested offered adequate brownout protection.

WAVEFORM

Backup power systems are also distinguished by the waveforms they create. The electrical generators that utility companies use produce sine-wave (or sinusoidal) power; the voltage and current smoothly alternate between polarities 120 times a second (a frequency of 60 hertz). However, electronic circuits such as those in a backup power system more easily create square waves, which abruptly switch between polarities. Considerable debate surrounds the issue of whether sine or square waves are better for your equipment. We find most of the waveform arguments irrelevant for PC

ENDS

	Perma Power Electronics Inc. **Perma Power SPS-800L**	Powercom America Inc. **Powercom UPS-600A**	SOLA **SOLA Advanced Network Plus UPS (600-va model)**	Superior Electric **Stabiline UPSY61008**	Tripp Lite **Tripp BC 600LAN**	TSi Power Inc. **TSi UPS-7200**	Unison **UniPower PS 6.0**	Upsonic **PC Might 80**
	$629.00	$399.00	$798.00	$1,295.00	$377.00	$619.00	$799.00	$369.00
	Standby	Standby	Line-interactive	On-line	Standby	Standby	On-line	Standby
	32	31	65	51	27	36	33	46
	6 x 8 x 16	3 x 15.8 x 15.8	10.2 x 8.2 x 18.9	9.3 x 5.9 x 15.8	6.5 x 5.3 x 14	3 x 16 x 12	3.5 x 14.3 x 18	9.5 x 6.5 x 16.5
	800	600	600	800	600	720	600	800
	4	3	6	3	4	3	4	4
	Modified sine	Modified sine	Modified sine	Pure sine	Modified sine	Modified sine	Pure sine	Modified sine
	□	■	■	■	□	■	□	■
	□	□	□	■	□	■	□	■
	■	■	■	■	□	■	■	■
	■	□	■	■	■	■	■	■
	□	□	■	□	□	□	□	□
	□	■	■	□	□	□	■	□
	□	■	■	■	■	■	■	□
	■	□	■	□	□	■	□	■
	□	■	□	□	□	■	□	■
	□	■	■	□	■	■	■	■
	□	□	Optional	□	■	■	■	Optional
	□	■	■	■	□	□	□	□
	N/A	□	■	□	N/A	N/A	N/A	N/A

backup power systems.

A related issue is the power factor. Although in DC circuits power (measured in watts) is simply the product of voltage and current according to Ohm's law, this relationship does not hold in AC circuits. Reactance in AC circuits can shift the relationship between the voltage and current waveforms so that peak current and peak voltage do not correspond. The power (watts) effectively available is then less than the product of voltage and current (the va or volt-amperes). The relationship between watts and va is called the *power factor.* For example, a backup power system rated at 800 va with a power factor of 0.75 produces 600 watts.

The power factor becomes important when you are sizing a backup power system. You cannot compare va and watt ratings without considering the power factors. To determine the size of backup power system you need, add the va ratings of the equipment you want to protect and compare the total to the backup power system ratings.

BATTERIES

All UPSs depend on batteries for their power reserves. Most use sealed lead-acid batteries or variations of this technology (lead-calcium or lead-cadmium) because of the low battery cost, relatively long life, and maintenance-free operation. Essentially these are car batteries in miniature. The only downside to sealed lead-acid batteries is that they are heavy and require more mass for every joule they store.

The number of available models of sealed lead-acid batteries is small, so you'll see that many of these backup power systems use the same battery model and manufacturer. To gain greater reserves, backup power system makers only need to add more batteries. Connecting multiple batteries in series yields a higher voltage input to the backup system's inverter, which adds efficiency because higher voltage circuits need to handle less current at a given power level. Most of these backup power systems link four 12-V batteries together to make a 48-V supply.

Batteries are rated in ampere-hours; at their rated voltage, each can store a distinct quantity of energy measured in *joules*—the product of voltage (volts), current (amps), and time (hours) for backing up your PC. The conversion circuitry of a backup power system operates at less than 100 percent efficiency. More efficient backup systems pull more life from a given size of battery.

If you are adding external batteries for longer operation during failures, a more efficient unit will make such expansion less costly. Of the 11 expandable units (the Alpha, the C-Power, Clary's OnGuard, the Controlled Power, the EPE, Exide's Powerware, IntelliPower's Bright UPS, ITT Constant Power's Dual

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Fact Files: *UPSs*

▶ Network Power Processor NPP-800

Acme Electric Corp., 20 Water St., Cuba, NY 14727; 800-325-5848, 716-968-2400.

List price: $799; PowerNet Manager for NetWare or Microsoft LAN Manager, $149; direct cabling for LANtastic or for VINES, $30.

Other models: NPP-650, $649; NPP-500 online, $749.

Circle 518 on reader service card

▶ Alpha CFR 600

Alpha Technologies Inc., 3767 Alpha Way, Bellingham, WA 98226; 206-647-2360.

List price: $1,686 (with intelligent interface); AlphaNet for NetWare, $204; AlphaNet for Microsoft LAN Manager, $245; direct cabling for VINES, $80.

Circle 519 on reader service card

▶ American Power Back-UPS 600 American Power Smart-UPS 900

American Power Conversion Corp., 132 Fairgrounds Rd., West Kingston, RI 02892; 800-788-2208, 401-789-5735.

List price: $399; PowerChute for NetWare, $99; direct cabling for LANtastic, Microsoft LAN Manager, or VINES, $29.

Other models: Back-UPS 900, $599; Smart-UPS 600, $599; Smart-UPS 900, $899.

Circle 520 on reader service card

▶ Fortress LI 660B

Best Power Technology Inc., P.O. Box 280, Necedah, WI 54646; 800-356-5794, 608-565-7200.

List price: $649; Check UPS II for NetWare, $179; direct cabling for NetWare, LANtastic, Microsoft LAN Manager, or VINES, $49.

Other models: Fortress LI 660B, $649; Ferrups ME700VA, $1,065; Ferrups ME850VA, $1,255; Patriot SPS 650B, $449; Patriot SPS 850B, $599.

Circle 521 on reader service card

▶ OnGuard PC-2400

Clary Corp., 1960 S. Walker Ave., Monrovia, CA 91016; 800-442-5279, 818-359-4486.

List price: $1,590; Systems Enhancement's PowerMon for NetWare, $99; PowerMon for Microsoft LAN Manager, $149.

Circle 522 on reader service card

▶ Controlled-Power LT Series Expandable UPS Model 850

Controlled Power Co., 1955 Stephenson Hwy., Troy, MI 48083; 800-521-4792, 313-528-3700.

List price: $1,255; PowerMon for NetWare or Microsoft LAN Manager, $199; direct cabling for NetWare, LANtastic, Microsoft LAN Manager, or VINES, $75.

Other models: LT Series Expandable UPS Model 700, $1,165.

Circle 523 on reader service card

▶ C-Power VPS-750

C-Power Products Inc., 2007 Industrial Blvd., Rockwall, TX 75087; 800-800-2797, 214-771-2179.

List price: $1,255; PowerMon for NetWare, $99; PowerMon for Microsoft LAN Manager, $149; direct cabling for NetWare or VINES, $29.

Circle 524 on reader service card

▶ PowerRite Pro PRA600A

Deltec Electronics Corp., 2727 Kurtz St., San Diego, CA 92110; 800-854-2658, 619-291-4211.

List price: $559; PowerMon or PowerCheck Pro for NetWare, $99; PowerMon or PowerCheck Pro for Microsoft LAN Manager, $149; direct cabling for LANtastic or for VINES, $39.

Other models: PowerRite Plus PRK600, $429; PowerRite Plus PRK900, $649.

Circle 525 on reader service card

▶ LanGarde 600

EFI Electronics Corp., 2415 S. 2300 West, Salt Lake City, UT 84119; 800-877-1174.

List price: $659.95; NetTrax for NetWare, $99.95; direct cabling for LANtastic, Microsoft LAN Manager, or VINES, $39.95.

Other models: LanGarde 900, $969.95.

Circle 526 on reader service card

▶ EPE/Topaz Integrity 800

EPE Technologies Inc., a subsidiary of Square D Corp., 1660 Scenic Ave., Costa Mesa, CA 92626; 714-557-1636.

List price: $1,395; PowerMon for NetWare, $99; direct cabling for LANtastic, Microsoft LAN Manager, or VINES, $29.

Other models: Integrity 800 rack-mount, $1,595; Topaz Powermaker 800, $699; Topaz Powermaker 800 VR, $799.

Circle 527 on reader service card

▶ Powerware Personal Series Model 800 VA

Exide Electronics Corp., 8521 Six Forks Rd., Raleigh, NC 27615; 800-554-3448, 919-872-3020.

List price: $1,199; SmartMon for NetWare, $149; direct cabling for VINES, $43; LAN Interface Circuit Board for Microsoft LAN Manager, $99.

Other models: ONEUPS Model 600 VA, $399; Powerware Personal Series Model 600 VA, $849.

Circle 528 on reader service card

▶ Abler Miniguard-600A

Golden Pacific Electronics Inc., 560 S. Melrose St., Placentia, CA 92670; 714-993-6970.

List price: $315; Abler's N3 for NetWare, LANtastic, or Microsoft LAN Manager, $60.

Other models: ABLER Microguard-750VA, $360.

Circle 529 on reader service card

▶ Bright UPS IQ 650

IntelliPower Inc., 10-A Thomas St., Irvine, CA 92718-2702; 714-587-0155.

List price: $799; PowerMon for NetWare or Microsoft LAN Manager, $99; direct cabling for LANtastic or VINES, $55.

Other models: Bright UPS IQ 800, $999.

Circle 530 on reader service card

▶ Dual Power DP900

ITT/Constant Power, Commerce Park, 14 Commerce Dr., P.O. Box 222, Danbury, CT 06813-0222; 800-348-8797, 203-790-7790.

Continues

UPS Fact Files

CONTINUED

List price: $999; PowerMon for NetWare, $149.95; PowerMon for Microsoft LAN Manager, $199; direct cabling for VINES, $30.
Other models: Dual Power DP600, $749; Executive Desktop ED800, $1,545.
Circle 531 on reader service card

▶ Power Backer Plus 600

Kensington Microware Ltd., 2855 Campus Dr., San Mateo, CA 94403; 800-535-4242, 415-572-2700.
List price: $649.95; direct cabling for NetWare, LANtastic, Microsoft LAN Manager, or VINES (free with UPS unit on request).
Other models: Power Backer Plus 800, $849.
Circle 532 on reader service card

▶ AccuPower Gold Model 750

Liebert Corp., 9650 Jeronimo Rd., Irvine, CA 92718; 800-222-5877, 714-457-3600.
List price: $1,249; AccuMon for NetWare, $139; direct cabling for Microsoft LAN Manager or VINES, $49; direct cabling for LANtastic, $99.
Other models: AccuPower Gold Model AU750 rackmount, $1,899; AccuPower Select APS600, $649; AccuPower Select APS900, $949.
Circle 533 on reader service card

▶ Meirick PowerPro 600SLR

Meirick Inc., 420 S. Hickory St., Mt. Vernon, MO 65712; 800-735-5069, 417-466-3941.
List price: $599; Meirick Network NLM for NetWare (free with UPS unit on request), $89; PowerMon for NetWare, $99; PowerMon for Microsoft LAN Manager, $149.
Other models: Meirick PowerPro 850SL, $699.
Circle 534 on reader service card

▶ Minuteman PowerMind 600

Minuteman UPS, P.O. Box 815188, Dallas, TX 75381; 800-238-7272, 214-446-7363.
List price: $579; Minuteman LANMaster for NetWare, LANtastic, Microsoft LAN Manager, or VINES, $119.
Other models: Minuteman Powermind 900, $829; Minuteman Alliance 750, $429; Minuteman MM850, $949;
Circle 535 on reader service card

▶ Network Security IPS/AI 800-US

Network Security Systems Inc., 9401 Waples St., San Diego, CA 92121; 800-755-7078, 619-587-7950.
List price: $799; LanSafe II for NetWare, $135; LanSafe/AI+ for Microsoft LAN Manager, $135; direct cabling for LANtastic or VINES, $49.
Other models: IPS/AI 600-US, $599.
Circle 536 on reader service card

▶ Oneac ON 900

Oneac Corp., 27944 N. Bradley Rd., Libertyville, IL 60048; 800-327-8801 ext. 5, 708-816-6000.
List price: $899; MopUPS basic for NetWare, $99; MopUPS advanced for NetWare, $129; MopUPS/RM for NetWare, $169; interface kit for LANtastic, Microsoft LAN Manager, or VINES, $39.
Other models: ON 600, $699; ON 900 rackmount, $1,049.
Circle 537 on reader service card

▶ Perma Power SPS-800L

Perma Power Electronics Inc., 5601 W.Howard St., Niles, IL 60714; 800-323-4255.
List price: $629; PowerMon for NetWare, $99.95; PowerMon for LANtastic, Microsoft LAN Manager, or VINES, $239.
Other models: SPS-600L, $495.
Circle 538 on reader service card

▶ Powercom UPS-600A

Powercom America Inc., 17155 Von Karman Ave., #108, Irvine, CA 92714; 714-252-8241.
List price: $399; PowerMon for NetWare, $99.
Other models: UPS-600, $359; UPS-600A, $399; UPS-650A, $319; UPS-800A, $399; SSI-800A, $499; ONL-600, $899.
Circle 539 on reader service card

▶ SOLA Advanced Network Plus UPS (600-va model)

SOLA, 1717 Busse Rd., Elk Grove Village, IL 60007-5666; 800-289-7652, 708-439-2800.
List price: $798; PowerMon for NetWare, $99; direct cabling for LANtastic, Microsoft LAN Manager, or VINES, $45.
Other models: Network UPS (600 VA model), $419; Network UPS (900 VA model), $679; Advanced Network UPS (900 VA model), $929; Advanced Network Rack-Mount UPS (900 VA model), $1,029; Micro UPS (900 VA model), $899.
Circle 540 on reader service card

▶ Stabiline UPSY61008

Superior Electric, a division of Dana Corp., 383 Middle St., Bristol, CT 06010-7488; 800-227-6469, 203-585-4500.
List price: $1,295; PowerMon for NetWare or Microsoft LAN Manager, $99.
Other models: Stabiline UPSY61008R rack-mount, $1,495.
Circle 541 on reader service card

▶ Tripp BC 600LAN

Tripp Lite, 500 N. Orleans St., Chicago, IL 60610-4188; 312-329-1601.
List price: $377; Power Alert for NetWare, $89; direct cabling for LANtastic, Microsoft LAN Manager, or VINES, $39.
Other models: BC 750LAN, $469; BC 900LAN, $549.
Circle 542 on reader service card

▶ TSi UPS-7200

TSi Power Inc., 3055 Northwoods Circle, Norcross, GA 30071; 800-874-3160, 404-263-6063.
List price: $619; PowerMon for NetWare, $139; direct cabling for LANtastic, Microsoft LAN Manager, or VINES, $39.
Circle 543 on reader service card

▶ UniPower PS 6.0

Unison, 500 N. Orleans St., Chicago, IL 60610-4188; 312-329-1601.
List price: $799; Power Alert for NetWare, $89; direct cabling for LANtastic, Microsoft LAN Manager, or VINES, $39.
Other models: UniPower PS 8.0, $999; UniPower PS 9.0, $1,009.
Circle 542 on reader service card

▶ PC Might 80

Upsonic, 1392 Industrial Dr., Tustin, CA 92680; 800-877-6642, 714-258-0808.
List price: $369; PowerMon for NetWare, Microsoft LAN Manager, or VINES, $89; direct cabling for LANtastic, $29.
Other models: PC Might 80VR (voltage regulation), $419.
Circle 544 on reader service card

Power, Superior Electric's Stabiline, the TSi, and Upsonic's PC Might 80) the EPE was most efficient—with the Exide, ITT, and SOLA a few percentage points below it. The worst was the IntelliPower, which was less than half as efficient and required twice the battery reserves for an equal running period.

Adding external batteries also varies in difficulty. We judged the Clary exemplary for the ease of installing extra reserves; we found the C-Power most difficult; and we voted the stub cable on the TSi the ugliest way (although among the easiest) to plug in additional battery power.

LONG LIFE

All chemical battery cells suffer general aging, and after three to five years they may no longer be able to run your network through a power failure. Unfortunately, there's no outward sign of this battery deterioration. Backup power system makers use a variety of strategies to cope with this problem. The most common means of monitoring battery condition is to check battery voltage; this gives a general indication of state of charge. But capacity and charge are not necessarily the same thing. About half of the units that we examined have special indicators or test modes that help you to determine whether or not their batteries are in need of replacement. Since battery failure is inevitable, you need to be concerned with the ease and affordability of battery replacement.

We noted two systems that provided exemplary battery access. The SOLA puts its batteries on a tray that easily slides out of the front of the unit once you release two knurled screws. Similarly, popping off the entire front panel of the Oneac ON 900 gives direct access to the batteries.

These two units, along with Clary's OnGuard, the Controlled Power, the EFI, and Golden Pacific's Abler, allow you to exchange batteries while the backup power system is hot. That is, you don't have to switch off your PC in order to replace the internal batteries (in the case of the Oneac and SOLA) or external batteries. When batteries do wear out, replacement costs are minimal, typically under $50.

BLINKING LIGHTS

All backup systems have indicators of some sort that allow you to monitor what they are doing. The minimum that all backup systems in this survey include is a light that indicates that they are switched on. All of the devices will also warn you when they are using their inverters to generate power for your PC (or in the case of double-conversion units, when AC is not available).

Indicators are valuable, particularly when coupled with audible annunciators. You could blow a fuse or unplug the backup power system, not notice the error, continue to work on your PC, then suddenly lose everything. All units except the EPE, Exide's Powerware, and Liebert's AccuPower have alarm annunciators. The inverters of some units, such as the Alpha, make so much noise that an annunciator might be unnecessary.

Most backup power systems (16 of those we tested) allow you to mute their audible indicators. The mute typically lasts until the final minutes of operation, at which point the units override the silence switch and add an audible "failure-imminent" warning.

Most of these units have an indicator that monitors the available battery capacity.

All but two of the backup power systems we tested—ITT Constant Power's Dual Power and the Tripp—have some kind of indicator that monitors the available battery capacity. More than half the units have "low battery voltage" test indicators of some kind to warn you about too-low battery voltage, and many have a discharge test.

NETWORK CONNECTIONS

The network connections we required in the backup power systems in this review are designed to link to your network server through a standard serial port. Software on the server monitors the operation of the standby system, notifies users of power failures, and finally shuts down the server.

Despite the diversity of the hardware, all these backup power systems boast similar network features. PowerMon software is used by 14. Notwithstanding the program name or origins, all of the network software offers the same basic set of warnings and indicators during a backup event. Besides the network link, most of these standby systems allow for notification of power failures to another location. Only three systems don't allow for remote notification: the American Power, the Kensington, and Tripp. The Liebert makes notification an option.

In addition, all but four standby systems allow their operational parameters to be remotely monitored, either through the network or by external connection (direct or through a modem). Those lacking this ability include the American Power Back-UPS 600, Kensington, the Perma Power, and the Tripp BC 600LAN. Two on-line units, the C-Power VPS-750 and Liebert's AccuPower, also lack remote monitoring. All but nine of these systems allow testing and diagnostics to be similarly handled remotely. Those lacking this ability include the American Power Back-UPS 600, Best, C-Power, Golden Pacific, Kensington, Meirick, Superior, Tripp, and Upsonic units. The Clary and Perma Power units also currently lack remote monitoring and testing but will be adding these abilities to future products.

For larger networks, the ultimate in remote monitoring and control comes with SNMP (Simple Network Management Protocol) compatibility. Several manufacturers have created their own proprietary links to SNMP, and power system makers are working to develop a MIB (Management Information Base) that will allow standardized monitoring at a central management console for any SNMP-compliant backup power system. Release of an SNMP standard for backup power systems is expected later this year. Of course, SNMP compatibility is an issue only for larger networks using that management protocol.

To guard against power problems, an ounce of prevention really is worth a pound of cure. The right backup power system can eliminate one source of disaster and ensure that your utility company's problems don't become your own. □

Raising the DOS Ceiling

Replacing the Nonsystem Message

BY NEIL J. RUBENKING

RAISING THE DOS CEILING

While trying to squeeze a little more memory out of DOS 5.0 on my 386, I discovered a way to use EMM386.EXE to raise the DOS ceiling to 704K. That leaves 679K free after loading DOS high!

The trick is to let EMM386.EXE use the VGA video segment A000–AFFF as conventional RAM. To gain more memory, simply include `I=A000-AFFF` on the EMM386.EXE command line in CONFIG.SYS. Here's how that line looks in my CONFIG.SYS:

```
DEVICE=C:\DOS\EMM386.EXE RAM NOEMS
 I=D000-DFFF I=A000-AFFF
```

When I first tried this, I expected to get another 64K UMB to load TSRs into. I was pleasantly surprised to discover that DOS's upper limit was extended to 704K instead. Remember, though: Remapping the video memory means you can't use any graphics.

Paul Raflik
Waukesha, Wisconsin

▶PC MAGAZINE: The I= switch normally specifies a range of memory that EMM386 can use for creating UMBs (upper memory blocks) by mapping EMS memory to the specified range. However, if the I= range is continuous with conventional memory (which ends just below segment A000), EMM386 will map EMS memory into that range as conventional memory, thus increasing the memory available for running programs. Once the video memory is in the hands of EMM386.EXE, though, you *must not* run any programs that use VGA graphics; the results could range from unpredictable to catastrophic! Note that if don't happen to have a monochrome monitor, you could conceivably include the range from A000–B7FF, yielding a DOS ceiling of 736K!

QEMM users will find that the included VIDRAM utility is a better way to use the VGA graphics video memory range for conventional memory. Enter the command VIDRAM ON and that range becomes immediately available; enter VIDRAM OFF and it's restored to use for VGA graphics. Even better, while VIDRAM is using the graphics memory range, it refuses all requests to go into VGA graphics mode, thereby avoiding any conflict. Still, you can get the same effect with EMM386 and a little bit of care.

REPLACING THE NONSYSTEM DISK MESSAGE

The cryptic DOS message

```
Non-System disk or disk error
Replace and press any key when
 ready
```

(which is displayed when you try to boot your computer but have left a disk that lacks system files in the A: drive) is actually copied onto floppy disks by FORMAT.COM. You can easily change the text using DEBUG. Just follow the steps listed here.

- Make a backup of FORMAT.COM in case something goes wrong!
- Go to your DOS directory and enter `DEBUG FORMAT.COM`.
- Enter `E CS:0F0C 07 "There's a disk in drive A:."`
- Enter `E CS:0F2C 0D 0A "Remove it and press any key. . ." 07 07 07`.
- Enter `W` to write the changes to disk.
- Enter `Q` to quit DEBUG.

Now format a floppy disk in drive A: and reboot the system with the disk still in the drive. You'll hear a beep and see the new (and much better) message, "There's a disk in drive A:. Remove it and press any key. . .". If you use a disk editor rather than DEBUG, find the second occurrence of the string "Non-System" and change it.

Raymond Connelly
Fremont, California

▶PC MAGAZINE: When you poke around DOS 5.0's FORMAT.COM with a low-level editor, you'll see the string "Non-System disk or disk error" four times. In two places, the familiar "Replace and press any key when ready" follows it, and in a third place, the old-fashioned *strike* appears instead of *press*. The second occurrence of this string, as Mr. Connelly points out, is the one copied to a floppy disk's boot sector during formatting.

The DEBUG method above works only on the FORMAT utility included with DOS 5.0. To patch any other, you must first locate the second occurrence of the error message. Before modifying anything, though, be doubly sure to retain an unchanged copy of FORMAT!

Once that's done, enter the command `DEBUG FORMAT.COM`. When DEBUG comes up, type `RCX` and hit enter. A hexadecimal number representing the size of

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the file will display. Press Enter again to return to the prompt. To find the appropriate string's distance from the beginning of the file, enter the command `S CS: 100 L #### 'Non-System'`, where #### is the file size number. (Note the use of single quotation marks rather than double.) Several addresses, in segment: offset format, should display. Substitute the offset of the second address for the value 0F0C above. Add 20 hex to the offset and replace the 0F2C entry with that result.

The original message is 69 characters long, including the carriage return/linefeed (represented in DEBUG by 0D 0A) after each line. You can substitute any string, but it must be exactly the same length to prevent program code from moving up or down in memory. You might, for example, use

```
The diskette in drive A: is not
 bootable
Remove it and press a key
```

If you choose a shorter message, pad it to 69 characters with spaces or add a 00 byte after the last character. Here's an example:

```
E CS:0F0C "Remove disk from drive A:,
 press a key" 0D 0A 00
```

This produces a message that's short and to the point. Note that although the replacement text consists of fewer than 69 characters, the original message remains after that point, thus providing the necessary fille. DOS, however, displays the message only up to the null. Strings longer than the limit may not be used.

CLEANING UP TRASHOUT.BAT

▶PC MAGAZINE: The November 24, 1992, User-to-User column featured a method for simulating the Macintosh trash can in the Windows 3.1 File Manager. The process involved creating the directory C:\TRASHCAN, opening a File Manager window on that directory, and minimizing the window. Then, instead of deleting files, groups of files, or directories, you'd simply drag them to the trash can. Recovering a trashed file became as simple as copying it back from the trash can.

To truly empty the trash can directory, I supplied a DOS 5.0 batch file called TRASHOUT.BAT, whose purpose was to delete all files and directories in and below that directory. Quite a few readers pointed out (via letters or PC MagNet) one major problem with the batch file, and several minor ones.

The biggest problem with the original TRASHOUT.BAT involved the lines designed to handle subdirectories of the trash can directory. These lines worked perfectly to delete all subdirectories and the files in them. But if the trash can contained *no* subdirectories, the batch file got stuck in an endless loop. In the revised version of TRASHOUT.BAT, shown in Figure 1, the four lines that follow the REMark that begins "Fill DIRLIST.DAT. . ." eliminate that problem.

TRASHOUT.BAT

Complete Listing

```
@ECHO OFF
REM ----------------------------------
REM TRASHOUT.BAT - empties C:\TRASHCAN
REM Requires DOS 5.0
REM ----------------------------------
IF NOT '%1'=='' GOTO OneDir
REM Modify the next lines so they switch to the drive
REM and directory that YOU use for batch files.
C:
CD \BAT
IF EXIST TRASHOUT.DAT GOTO AllWell
ECHO The essential file TRASHOUT.DAT is missing.
ECHO %0 cannot function without this file.
GOTO Done
:AllWell
REM Fill DIRLIST.DAT with a list of all directories
REM under C:\TRASHCAN, in reverse sorted order
DIR C:\TRASHCAN /A:D /B /S /-L > DIRLIST.DAT
COPY DIRLIST.DAT ANYLEFT.DAT > NUL
IF NOT EXIST ANYLEFT.DAT GOTO OutOfLoop
SORT /R < ANYLEFT.DAT > DIRLIST.DAT
:===== Loop ==========
  COPY TRASHOUT.DAT + DIRLIST.DAT TRASHTMP.BAT > NUL
  CALL TRASHTMP
  FIND /V "trashout" < TRASHTMP.BAT > DIRLIST.DAT
  COPY DIRLIST.DAT ANYLEFT.DAT > NUL
  IF NOT EXIST ANYLEFT.DAT GOTO OutOfLoop
  DEL ANYLEFT.DAT
  GOTO Loop
:===== OutOfLoop =====
DEL DIRLIST.DAT
DEL TRASHTMP.BAT
ECHO Now emptying the TRASHCAN
ATTRIB -R-H-S C:\TRASHCAN\*.* /S
IF NOT EXIST C:\TRASHCAN\*.* GOTO Done
ECHO Y | DEL C:\TRASHCAN\*.* > NUL
GOTO Done
:===== OneDir ========
ECHO Wiping out directory %1
IF NOT EXIST %1\*.* GOTO DirEmpty
ECHO Y | DEL %1\*.* > NUL
: DirEmpty
RD %1
:===== Done ==========
```

Figure 1: **This batch file fixes a bug in the original TRASHOUT.BAT, whose purpose was to delete all files and directories in or below C:\TRASHCAN.**

One reader accidentally deleted TRASHOUT.DAT; the new version warns users if this essential file doesn't exist. Other readers pointed out that TRASHOUT would be foiled by the existence of a hidden or system file among the subdirectories, so I added -H-S to the switches for the ATTRIB command. Thanks to all who submitted questions or suggestions regarding this handy batch file.

You can download TRASHOUT.BAT from PC MagNet's Utilities/Tips Forum, archived as TRASH.BAT. □

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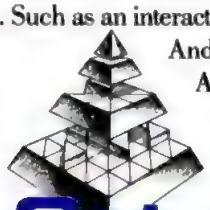

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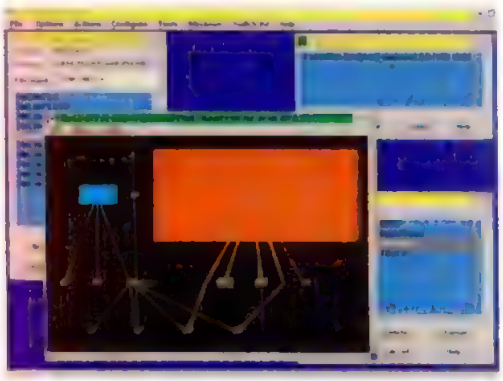

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CIRCLE 122 ON READER SERVICE CARD

Using the DOS 6.0 Antivirus Tools

BY JEFF PROSISE

In the past, you had to purchase additional software to protect your computer from viruses. Not any more. DOS 6.0 comes with a pair of virus fighters you can use to protect the data on your hard disk: MSAV, which provides passive protection against viruses, and VSAFE, which provides active protection against viruses and Trojan Horses. If you haven't used antivirus programs before, it might not be clear to you how to best use the DOS 6.0 antivirus tools. Here, then, is a close-up look at the forms of protection that MSAV and VSAFE provide—and some practical advice for putting them to work on your PC.

For more background on viruses, see the March 30, 1993, Tutor column ("Viruses: How They Work and How to Avoid Them"), which describes the two types of computer viruses: viruses that infect the bootstrap code in a floppy disk's boot sector or the master boot record in a hard disk's partition table (often called *boot sector* or *partition table* viruses), and viruses that infect executable files. Common examples of boot sector/partition table viruses include the Michelangelo, Joshi, and Stoned viruses. Two examples of viruses that attack executable files are the Jerusalem virus and the Friday the 13th virus.

Trojan Horses are not viruses at all, but are every bit as dangerous. A Trojan Horse is a program that masquerades as a legitimate utility or application but destroys the files on your hard disk or does other harm to your system when you run it.

MSAV: PASSIVE VIRUS PROTECTION With MSAV, scanning a disk (or several disks) for viruses is easy. Just type MSAV to start the program, and you'll see the screen shown in Figure 1. To scan the current drive for viruses (the current drive—or *Work Drive*—is listed in the lower-right-hand corner of the screen), click the Detect button. To scan any other drive, click the Select New Drive button, select the drive letter, and click Detect. MSAV will begin by scanning memory for viruses and will then proceed to scan the drive. It's important that MSAV scan memory first, because many viruses thwart attempts to identify them on-disk once they are resident in memory. (The Joshi virus, for example, intercepts calls to read the sector that holds a hard disk's master boot record and returns the contents of the original master boot record that was displaced when the virus infected the disk; to an antivirus program, the disk appears healthy unless Joshi is detected in memory first.) If it detects a virus, MSAV notifies you of that fact and in most cases will offer to remove the virus for you. As an alternative, you can select the Detect and Clean button instead of the Detect button, and MSAV will automatically attempt to remove the virus upon detection.

Among the bundled utilities that come with the latest version of DOS are MSAV and VSAFE, which provide remedial and preventive treatment for computer viruses.

You can run MSAV in batch mode by starting it with the /P switch. This is the best way to run it if, for example, you add it to your AUTOEXEC.BAT file to scan for viruses each time your computer is started. The command

```
MSAV C: /P
```

scans drive C: for telltale signs of viruses, while the command

```
MSAV /L /P
```

scans all local (nonnetwork) drives except A: and B:. If your PC is networked and you'd like MSAV to scan network drives for viruses, too, use the /A instead of the /L switch. /A causes MSAV to scan *all* drives except A: and B:. You can automatically remove viruses as they are detected by adding the /C (for Clean) switch, as in

```
MSAV /L /P /C
```

The first time MSAV scans a hard disk, it creates a file named CHKLIST.MS in each directory that contains executable files. CHKLIST.MS contains checksum information corresponding to each executable file in the directory. This serves two purposes. First, it allows subsequent disk scans to proceed more quickly, because instead of physically scanning each executable file for virus signatures, MSAV can simply compute new checksums and compare them with the ones recorded in CHKLIST.MS. Second, it allows MSAV to detect viruses whose signatures it doesn't recognize. Executable files don't change often (most don't change at all), so a modified executable file is one warning sign of a virus attack. (One example of when an executable might change is if the program stores user-preference information right in its executable file.) If you don't want your hard disk littered with checksum files, start MSAV in full-screen mode, select

Options, and uncheck Create New Checksums. Following this procedure will prevent MSAV from creating checksum files, but it will also slow down disk scans.

It's a good idea to check any newly acquired floppy disk to see if it is infected with a virus before you use it. To do this, just insert the disk into drive A: and type the following line:

```
MSAV A: /P
```

Similarly, if you download a file to your hard disk from a bulletin board and want to check it for viruses before executing it, type

```
MSAV filename /P
```

where *filename* is the name of the file. It's important to realize that your computer can't be infected by a virus simply by scanning a virus-infected disk or file for viruses. Your computer can become infected, however, if you boot from a floppy disk infected with a boot sector virus or execute a virus-infected program. If MSAV detects a virus-infected floppy disk, either allow MSAV to remove the virus or discard the disk altogether. If MSAV detects a virus-infected file, do not run that file or any other file on the infected disk until the virus is removed.

If you run Windows, you can use the Windows version of MSAV (titled MWAV) in lieu of MSAV. MWAV is almost identical to MSAV functionally, and it is a native Windows application, so you don't have to run it in a DOS box. In addition, it comes in the DOS 6.0 package for no extra charge.

VSAFE: ACTIVE VIRUS PROTECTION Using MSAV is like seeing your doctor for a regular physical: It won't stop infections before they occur, but it will reveal infections that are already present so that they can be treated. Using VSAFE is like being injected with a vaccine; VSAFE provides active protection against computer viruses and is effective in stopping most attacks before they take place.

There is a price, however. VSAFE is a TSR that requires about 44K of RAM (if you load it into EMS or XMS memory, it can use just 7K of conventional memory). VSAFE also slows a PC's performance ever so slightly, because it intercepts certain disk function calls and performs additional processing of its own before allowing the function calls to proceed.

VSAFE monitors your PC for suspicious activity that might signify the presence of a virus or Trojan Horse program. Figure 2 lists the eight options that VSAFE supports. You can toggle individual options on or off from the command line (when installing VSAFE) or from the VSAFE Warning Options window, which pops up when you press Alt-V. The command

```
VSAFE /1- /2- /3- /4- /5- /6+ /7+ /8+
```

enables options 6, 7, and 8 and disables the others. Since options 1, 4, 5, and 6 default to *on* and options 2, 3, 7, and 8 default to *off*, you can shorten this command to

```
VSAFE /1- /4- /5- /7+ /8+
```

VSAFE Options

Number	Option	Use when...
1	HD low-level format	You want to be informed whenever a program attempts to reformat your hard disk (useful in combating destructive viruses and Trojan Horse programs).
2	Resident	You want to be informed whenever a program makes itself memory-resident.
3	General write protect	A virus has infected your PC and you want to prevent other disks from becoming infected.
4	Check executable files	You want VSAFE to check program files for viruses each time they are run.
5	Boot sector viruses	You want VSAFE to check every floppy disk that you insert for boot sector viruses.
6	Protect HD boot sector	You want to be informed whenever a program attempts to copy information to your hard disk's boot sector (the sector that contains the master boot record and partition table).
7	Protect FD boot sector	You want to be informed whenever a program attempts to copy information to a floppy disk's boot sector.
8	Protect executable files	You want to be informed whenever a program attempts to modify an executable program file.

Figure 2: **These options let you customize what you want DOS 6.0's VSAFE utility to check for. Note that options in red type are on by default.**

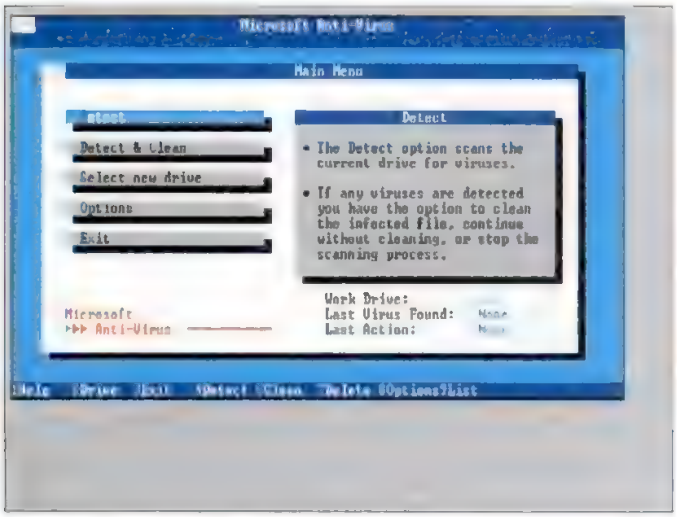


Figure 1: **When it is run in full-screen mode (started without the /P switch), MSAV displays this interactive control panel.**

Figure 3: **When a program attempts to write to the sector of your hard disk that contains the partition table and master boot record, VSAFE displays this warning message. Selecting Stop prevents the disk access from occurring.**

This is an effective configuration for combating most types of viruses, because it heads off attempts to write to a floppy disk's boot sector or to a hard disk's partition table sector (the method by which boot sector/partition table viruses spread) and attempts to modify an executable file (the method by which viruses that infect executable files spread).

An alternative way to combat the spread of viruses is to install VSAFE with the command

```
VSAFE /1- /2- /3- /4+ /5+ /6- /7- /8-
```

or

```
VSAFE /1- /2- /3- /4+ /5+ /6+ /7+ /8+
```

When option 5 is enabled, VSAFE checks for boot sector viruses on every floppy disk that you insert into your computer. The first time the disk is accessed, you're warned if it's infected so you can remove it before the virus has a chance to take hold. Similarly, when option 4 is enabled, VSAFE checks every executable file that you run to see if there are any viruses present. This slows down program loading somewhat, but it virtually ensures that you can't catch a virus from an infected executable. A side effect of using option number 4 is that VSAFE will create checksum files in the directories where executables are stored. You can prevent VSAFE from creating checksum files by starting it with the /D switch. Note that this slows down program loading even more, because VSAFE must now scan each executable file for virus signatures rather than just compute and compare a checksum.

You can see an example of how VSAFE works by installing it with the command

```
VSAFE /6+
```

and typing FDISK /MBR at the DOS prompt. FDISK /MBR (the /MBR switch is undocumented) rewrites your hard disk's master boot record. But because option 6 is enabled, VSAFE watches for attempts to write to the sector that holds the master boot record and sends you a warning message when such attempts occur. Just after you press Enter to execute FDISK/MBR, VSAFE will pop up the dialog box shown in Figure 3. Select Stop to prevent the disk access from occurring. Had this been a partition table virus attempting to infect your hard disk, it would have been stopped in its tracks. Another way to test VSAFE is to enable option number 3, which stops all disk writes in their tracks, and then attempt to copy a file.

If you're worried about Trojan Horses, enable options 1 and 6 (actually both options are enabled by default, so simply not disabling them is enough to make sure they're activated). This will prevent a Trojan Horse from trashing your hard disk's boot sector or reformatting any part of the disk. However, neither one of these options will thwart a Trojan Horse that either deletes files from your disk or bypasses the hard disk BIOS and writes directly to the disk.

If VSAFE's default hotkey of Alt-V conflicts with another program that you use, you can change the hotkey with the /A or /C switch. The /A switch changes the hotkey to Alt plus a character; /C changes the hotkey to Ctrl plus a character. The command

```
VSAFE /CV
```

installs VSAFE and changes the hotkey to Ctrl-V. Similarly, the following command

```
VSAFE /AS
```

loads VSAFE and changes the hotkey to Alt-S. In both cases, options 1, 4, 5, and 6 are enabled and options 2, 3, 7, and 8 are disabled, since there are no switches overriding the defaults. Note that if there are no other TSRs loaded after VSAFE, you can unload VSAFE by running it with the /U switch.

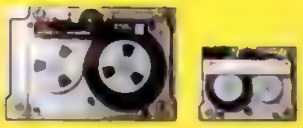
No antivirus utility is perfect, but used properly, MSAV and VSAFE can drastically reduce the chance that a virus will spread to your PC.

If you wish to use VSAFE with Windows, install VSAFE before starting Windows and then run MWAVTSR once Windows is started. MWAVTSR allows VSAFE to pop up warning messages while Windows is running. It also adds a control panel similar to the one that is displayed when you press Alt-V in DOS and from which you can toggle individual options on and off. If you use Windows 3.1, add MWAVTSR to your Startup Group. If you use Windows 3.0, add the command

```
LOAD=C:\DOS\MWAVTSR.EXE
```

to the [WINDOWS] section of WIN.INI to load MWAVTSR automatically each time Windows is started.

No antivirus utility is perfect, but used properly, MSAV and VSAFE can drastically reduce the chance that a virus will spread to your PC. □



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More Techniques for Easier Programming in FoxPro

BY JIM KORENTHAL

In the last issue I discussed a number of useful techniques for programming database applications with FoxPro. Now we will further develop some of those ideas and add a few new tricks as well.

EASY ERROR RECOVERY This tip can save you hours of frustration. Although FoxPro provides a rich development environment, it still has some rough edges when it comes to error recovery. As your application becomes more complex, it's all too easy to introduce a coding error that hangs FoxPro. When this happens you have to reboot—unless you have added one simple line to your program's initialization code:

```
on key label Alt+F11 cancel
```

With this line, you need only press Alt-F11 if FoxPro hangs. This forces a cancel command that will usually return you to the command window with keyboard control restored.

CONVERTING DATA TYPES Figure 1 lists a simple routine you'll find especially useful during program development and debugging. It converts an argument of any standard data type (except General, which is not appropriate for conversion) into a character string. The indented lines below are a sampling of the return values you get when using this string function. (The initial question mark tells FoxPro to evaluate and display what follows.)

```
? string(123.456)
    123.456
? string({4/9/51})
    04/09/51
? string(.T.) + " / " + string(.F.)
    .T.  / .F.
? string("one") + string(57)
 + string("two")
    one57two
```

As shown in Figure 1, FoxPro's type() function takes *arg*, a character string that is the name of a variable, as its argument. The function returns a single character that represents the argument's type—C for character, N for number, and so on.

If *arg* is already a character type, no conversion is necessary; the argument itself is simply returned. Converting a date requires use of FoxPro's date-to-character function, possibly with the addition of a second argument to convert to year-month-day form. Logical values are converted into .T. or .F. with FoxPro's powerful iif() function. The statement

Here are additional ways you can take advantage of the power in FoxPro and overcome some of its "gotchas."

```
return iif( arg , ".T." , ".F." )
```

is equivalent to

```
if arg
    return ".T."
else
    return ".F."
endif
```

but is shorter than the latter version, and executes faster as well. Memo fields are converted by concatenating them with a null string.

Converting numbers is not as straightforward as you might think. Fox itself provides a str() function that converts a number into a string, but that function has two limitations. First, str(99) pads the returned string 99 with preceding blanks, which we don't want. Second, str(99.99) returns the same thing as str(99). The decimal places are lost unless you explicitly ask for them.

Look again at the `case t = "N"` section of the code in Figure 1. You'll see that decimals are preserved by using the three-argument form of the function:

```
str(number, width, decimals)
```

The *width* is the number of characters that will comprise the returned string; this must be specified in order to use the third argument. *Decimals* is the number of decimal places to be returned. The string() function code calls for eight decimal places in a 20-character string. It also removes leading blanks, all trailing zeros, and any trailing decimal point that remains after the zeros are removed.

DISPLAYING MULTIPLE DATA TYPES FoxPro's debug and trace windows can be awkward to use. Often it's easier to track down a problem by using a WAIT WINDOW statement. In its simplest form, this command puts a message window on the screen and waits for a keystroke or mouse click before exiting. You can enter debugging information like this:

```
wait window
 "The value of x is " + x
```

That's fine if *x* is a character string. But what if *x* is a number, or a date, or some other type? Unless *x* is first converted into a string, the WAIT WINDOW statement fails and you'll never get its value.

Suppose that you want to display multiple fields of different types in WAIT WINDOW. Assume, for example, that CUSTOMER is a string, AMOUNT is a number, PAYDATE is a date, and you

STRING() FUNCTION

Complete Listing

```
function string
    parameters arg
    private t, s
    t = type("arg")
    do case
        case t = "C"          && it's already a string
            return arg
        case t = "N"          && it's a number
            s = ltrim(str(arg, 20, 8))
            do while right(s, 1) = "0"
                s = left(s, len(s) - 1)
            enddo
            if right(s, 1) = "."
                s = left(s, len(s) - 1)
            endif
            return s
        case t = "D"          && it's a date
            return dtoc(arg)     && optionally, use dtoc(arg, 1)
        case t = "L"          && it's a logical (true or false)
            if arg
                return ".T."
            else
                return ".F."
            endif
        case t = "M"          && it's a memo field
            return arg + ""
        otherwise             && it's "U" (undefined) or "G" (general)
            return "****"
    endcase
*end function string
```

Figure 1: **The string() function converts arguments of different data types into character strings in FoxPro.**

want to display the output in this format:

```
Customer A123 paid $5.00 on 12/25/93
```

You could accomplish this in FoxPro by writing

```
wait window "Customer "
 + CUSTOMER +
 "  paid $" +
 ltrim(str(AMOUNT,10,2)) +
 " on " + dtoc(PAYDATE)
```

That long and complicated entry could be greatly simplified by using the values() function I've written, which has the much simpler syntax:

```
wait window values(
 "Customer ", CUSTOMER, "
 paid $", AMOUNT, " on ",
 PAYDATE )
```

The values() function code is listed in Figure 2; it builds on the string() function in Figure 1 and takes up to ten arguments.

FoxPro procedures and functions can be called with a varying number of arguments. When a function declares more parameters than the number of arguments supplied, the missing parameters assume the value .F. (logical false).

The terms *argument* and *parameter* are often confused with each other. Strictly speaking, you supply *arguments* when you call a function; the function's *parameters* take on the values of the arguments. So in this example, p1 through p10 are the parameters, and the actual values we pass are the arguments. Confusion reigns in FoxPro itself, since you use FoxPro's parameters() function to discover the number of *arguments* passed to the current function!

In any event, you must be careful to save the value of parameters() before you call any other function, since parameters() will return the number of arguments for whatever function was called last. You can safely use parameters() as an argument to the min() function, as is done in Figure 2, since a function's arguments are evaluated before the function is called.

The values() function initializes *rVal* as a null string and then concatenates each argument in turn. The first argument is `eval("p1")`, the second is `eval("p2")`, and so on.

The parameter names are built with the help of the string() function. The loop is executed once for each parameter, and the variable *j* holds the parameter number. We use string() to build the name of the current variable, from *p1* to *p10*.

The string() function is then invoked again to obtain a character-string version of each argument's value. Then the string is appended to *rVal* and the next argument is processed. When all the arguments have been thus processed, the concatenated character string *rVal* is returned and the work of the values() function is done.

If you wish to allow more than ten arguments, you need only add *p11*, *p12*, and so forth, and increase the 10 in the min() function. Note that initially declaring the function's internal variables as *private* ensures that they won't conflict with any public variables of the same name.

INCREMENTING EMBEDDED NUMBERS

It's a common practice to use invoice numbers that begin with a character string and end with numbers. Sometimes the number is embedded within two character strings, for example, XX-9999-a. The function bumpNumIn(), which is listed in Figure 3, is designed to let you automatically generate successive invoice numbers or other keys when the format of the key isn't wholly numeric. BumpNumIn() takes a character string argument in which an integer is embedded and returns a similar string with the numeric part "bumped," or incremented by one. For example, `bumpNumIn("abc123de")` would return `"abc124de"`.

VALUES() FUNCTION

Complete Listing

```
function values
    parameters p1, p2, p3, p4, p5, p6, p7, p8, p9, p10
    private j, rVal, nParms
    nParms = min( parameters() , 10 )
    rVal = ""
    for j = 1 to nParms
        rVal = rVal + string(eval("p" + string(j)))
    endfor
    return rVal
*end function values
```

Figure 2: **The values() function uses the string() function of Figure 1 to concatenate up to ten arguments for display in a WAIT WINDOW.**

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The FOR loop in Figure 3 scans the argument to find the first digit using isdigit(), a built-in FoxPro function that returns .T. only if the first character of its argument is a digit. If no such digit is found, bumpNumIn() simply returns its argument. If a digit is found, the function points to position *j*, the first digit.

The next statement does the actual "bumping." `Left(s,j - 1)` is the part of the argument before the first digit. `Substr(s,j)` is the argument from the first digit to the end. The line

```
Val(substr(s,j))
```

returns the numeric value of the string of digits. Note that the val() function will stop parsing as soon as it sees a nondigit. The actual incrementing is performed by

```
Val(substr(s,j)) + 1
```

after which str() and ltrim() convert the value into a string with no blanks.

At this point, *t* holds everything needed except for the part of the argument that comes after the number. For instance, an argument of `"abc123de"` results in *t* being equal to `"abc124"`. So the string is scanned to find the first nondigit after the number, and then the iif() function is used to tack on either the trailing part of the argument (`"de"` in the example here), or `""`—the null string—if the argument ends in a number.

USING NAME EXPRESSIONS Macros have long been an integral part of Xbase languages. But though they are sometimes necessary, macros can bloat your code and cause your application to run more slowly. The macro concept is simple—you write *&varname*, where *varname* is the name of a character variable, and the value of the variable is substituted in the statement at runtime. For example,

```
x = "myfile"
use &x
```

will run just as if you had written

```
use myfile
```

The reason for the slowdown is that the macro must be *expanded* (*x* must be replaced with *myfile*) and compiled at runtime. Compilation at runtime is necessary because the variable might expand to more than a simple filename, as in

```
x = "myfile noupdate alias master"
use &x
```

In fact, it could be anything at all, even an entire FoxPro statement:

```
x = "use myfile noupdate alias master"
&x
```

Runtime compilation not only slows execution; it also forces FoxPro to include the full compiler code if you create a standalone .EXE file, greatly inflating the size of your executable. But there's an easy way around the problem in many cases: Use *name expressions* instead of macros. A name expression is similar to a macro substitution, except that (1) it's written by enclosing the character variable in parentheses, and (2) it's restricted to a *single name*, such as a filename, a field, a variable, or a window. The example below does the same thing as the first macro example above:

```
x = "myfile"
use (x)
```

You'll get an error if you assign "myfile noupdate" to *x*, because the use of the name expression implies that *x* will *only* be the name of a file in this context. But, you can legitimately write the following:

```
x = "myfile"
use (x) noupdate
```

Since the FoxPro program knows to expect only a filename between the parentheses, it can precompile the statement and won't include compiler code in the .EXE file.

A name expression can be more than just handy; in some situations it saves the day. Suppose you want to set an index order to one of many *tags* (loosely speaking, tags are the names of indexes), depending on the value of the character variable *tagName*. These statements will execute correctly:

```
tagName = "LASTNAME"
set order to tagName
```

FoxPro first checks to see whether *tagName* is actually the name of a tag. If not, FoxPro treats it as a variable that holds a tagName. But the following statements cause trouble:

```
veryLongTagName = "LASTNAME"
set order to veryLongTagName
```

If you try it, this code will *seem* to work, but in fact it will have corrupted FoxPro's internal memory! Microsoft has acknowledged that this bug appears in all existing versions of FoxPro In the Windows version, the bug often bites by causing a GPF (General Protection Fault) when FoxPro exits. DOS won't trap the

BUMPNUMIN() FUNCTION

Complete Listing

```
function bumpNumIn
    parameter s
    private t, j
    for j=1 to len(s)
        if isdigit(substr(s, j))
            exit
        endif
    endfor
    if j > len(s)
        return s
    endif
    t = left(s,j - 1) + ltrim( str( val(substr(s,j)) + 1 ) )
    for j = j + 1 to len(s)
        if !isdigit(substr(s,j,1))
            exit
        endif
    endfor
    return t + iif( j > len(s) , "" , substr(s,j) )
*end function bumpNumIn
```

Figure 3: **BumpNumIn() takes a character string with an embedded number and bumps the numeric portion up by one. This is useful for generating invoice numbers.**

Radio Button Spacing

```
(a)

        (●) Ham          ( ) Liverwurst   ( ) Bratwurst    ( ) Sausage

(b)

        (●) Ham   ( ) Liverwurst   ( ) Bratwurst   ( ) Sausage

(c)

        (●) Ham          ( ) Liverwurst
        ( ) Bratwurst    ( ) Sausage
```

Figure 4: **By defining each member of a group of radio buttons as a "group of one," you can eliminate the unattractive spacing (a) that results from FoxPro's fixed-length labels. The result is shown in (b). The same technique allows you to arrange the buttons as shown in (c).**

Radio Button Functions

```
procedure zapButtons          && deselect all the buttons
    store 0 to rButHam, ;
               rButLiverwurst, ;
               rButBratwurst, ;
               rButSausage
*end procedure zapButtons
procedure showButtons         && refresh the button displays
    show get rButHam
    show get rButLiverwurst
    show get rButBratwurst
    show get rButSausage
*end procedure showButtons

function rButHam              && Ham radio button pressed
    do zapButtons
    rButHam = 1
    do showButtons
    ...  (whatever else we want to do when this button is pressed)
*end function rButHam

function rButLiverwurst       && Liverwurst button pressed
    do zapButtons
    rButLiverwurst = 1
    do showButtons
    ...
```

Figure 5: **This set of functions lets you duplicate the functions of FoxPro's radio buttons, while at the same time arranging the buttons in whatever way you wish. You would add similar routines for the rButBratwurst and rButSausage functions.**

Using Radio Buttons

```
x = iif( rButHam        != 0 , "Ham" , ;
    iif( rButLiverwurst != 0 , "Liverwurst" , ;
    iif( rButBratwurst  != 0 , "Bratwurst" , ;
    iif( rButSausage    != 0 , "Sausage" , "*** Error *** ))))
?  "You ordered " + x
```

Figure 6: **You can use radio buttons by checking their status anywhere in your code. Here we use an iif() statement to determine which radio button is checked.**

error, but it can crop up as a seemingly random problem at any point during your program execution.

The problem lies in Fox's handling of long variable names. *Normally* you can safely use a very long name, for all characters beyond the tenth are ignored. But in the SET ORDER command (and possibly some others), FoxPro apparently overruns an internal buffer when truncating the long variable name to ten characters. Once this happens it's impossible to predict the effect on later code.

Fortunately, the error occurs only when you don't use a macro or a name expression. This code solves the problem:

```
veryLongTagName = "LASTNAME"
set order to (veryLongTagName)
```

This can be a nasty bug to track down, but at least it has a simple solution!

BETTER RADIO BUTTONS One rather annoying thing about FoxPro is that it makes all your radio button labels the same length, no matter how long the actual labels are. (Radio buttons are like check boxes except that only one radio button in a group can be selected at a given time.) This fixed-length treatment leads to the awkward spacing of items shown in Figure 4(a).

The buttons appear unevenly spaced because Fox allots them all the space necessary to accommodate the longest label (Liverwurst, in our example).

With a little clever coding you can override FoxPro's assumption and produce the kind of spacing seen in Figure 4(b) or 4(c).

The trick is to define the buttons separately, as "groups of one," instead of putting them all in a single group. If you do this, however, you must then also write your own code to make sure only one button can be selected at a time.

In the example shown in Figure 4, you would use the Screen Builder to place the Ham button where you wanted it, and you would define it as a radio button group with only one button. The button has the variable name *rButHam*, and its VALID clause (executed when the mouse is clicked on that button) is the expression rButHam(). You would then define the other buttons similarly.

You must now add the following to your program's initialization code:

```
* initialize fudged radio buttons
* rButHam = 0
rButLiverwurst = 0
rButBratwurst = 0
rButSausage = 0
```

These initializations are required because FoxPro will otherwise begin with all the buttons displayed in a "selected" state. (By default, FoxPro selects the

first—or only—button of each group at program startup, and you've told FoxPro to treat each of the buttons as an entire group.) Since any nonzero value for a button's associated variable means the button is selected, you set the variables to zero to deselect them. The statement `rButHam = 0` is commented out because you *want* that button to be selected on startup. The commented statement simply serves as a reminder that this button is part of the pseudo-group.

In the program's cleanup section (or in its main .PRG file, if you follow the program organization suggestion which was given in the last issue) you would include the code shown in Figure 5. Now when a button is pressed, its VALID routine deselects all the buttons. Then the particular button selected and all the other buttons are redisplayed to show the current selection. The VALID routines then take the appropriate action(s) for that selection.

Note that you may want nothing extra at all to be done when each button is pressed; the status of each button may simply be checked in other parts of your program and action taken accordingly. For example, if you wanted to check whether the Ham radio button was currently selected, you'd write

```
if rButHam != 0
    . . .  (button is selected)
else
    . . .  (button not selected)
endif
```

Figure 6 shows how you can use nested iif() statements to check the values of all the radio buttons at once.

HOTKEY FIELD VALIDATION For fast data entry, you don't want to force the operator to lift his hands from the keyboard any more often than necessary. Mousing around a data entry screen is easy, but for peak efficiency you want to stick to the keyboard as much as possible.

When there are many fields to enter, especially when data is coming in randomly, it's useful to have hotkeys that immediately jump to important data fields. You do this by changing the current object to the object number of the new field to which you want to go. For example:

```
_curobj = objnum(newField)
```

But there's a "gotcha" in FoxPro. Although you can define an ON KEY LABEL (a keyboard interrupt) that jumps to another field, the VALID clause for the field you are leaving is bypassed. Thus, if you jump from the field COST to the field PHONENUM, a TOTALCOST field computed in the VALID clause for COST won't be updated!

There is a solution, but it involves a bit of trickery. What you do is force the current field's VALID clause to be executed by "stuffing" a Tab into the keyboard buffer before the jump to the new field. The Tab will cause the current field to be exited, and thus its VALID clause will be executed.

This is not as simple as it sounds, however. You can't just write something like

```
keyboard "{Tab}"
_curobj = objnum(newField)
```


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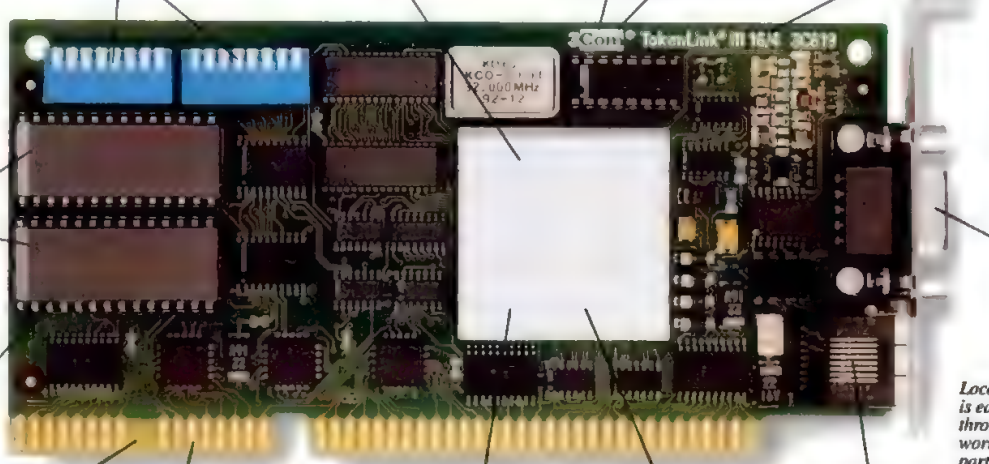

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The first statement puts a Tab character in the keyboard buffer, just the same as if you pressed the Tab key on the real keyboard. The second statement moves to the new field. But it won't do the job!

It won't work because the Tab will be processed only when FoxPro is waiting for input, that is, when no other program statements are being executed. Thus, although the Tab is in the keyboard buffer, it won't be seen by FoxPro until *after* the cursor moves to its new field. But that defeats the purpose of using the Tab to force FoxPro to validate the *old* field.

The trick here involves stuffing the keyboard buffer, then relinquishing control to FoxPro, then regaining control after the Tab has been processed. First you place a series of hotkey definitions in the initialization code:

```
on key label Alt+A do validGo ;
    with "phonenum"
on key label Alt+B do validGo ;
    with "country"
on key label Alt+C do validGo ;
    with "invoice.payment"
```

Each of these statements defines a hotkey and the field to be jumped to when the hotkey is pressed. The destination field names are expressed as character strings and may include work area aliases (such as "invoice.payment" above) if the screen's fields come from more than one work area.

Next, either in the cleanup section or in the master .PRG file, enter the procedure shown in Figure 7. To illustrate how this procedure works, assume you're on the LASTNAME field and you press Alt-A. Given the initialization code shown above, the validGo procedure is entered with `nextobj = phonenum` and `forReal = .F.` (Again, if you omit an argument, it's given a default value of .F.)

Because forReal is false, validGo saves the current ON KEY LABEL settings (that's what PUSH KEY does). Then it redefines the F2 key to call validGo with the same first argument, but with the second argument equal to .T. instead of the default .F. (There's nothing special about F2—any key would do.) The keyboard is then stuffed with a Tab key and an F2 key, and validGo exits, giv-

VALIDGO() FUNCTION

Complete Listing

```
procedure validGo
    parameters nextobj, forReal
    if not forReal
        push key
        on key label F2 do validGo with "&nextobj", .T.
        keyboard "{TAB}{F2}"
    else
        pop key
        _curobj = objnum(&nextobj)
    endif
*end procedure validGo
```

Figure 7: **This function forces the VALID clause to be executed when you hotkey from field to field.**

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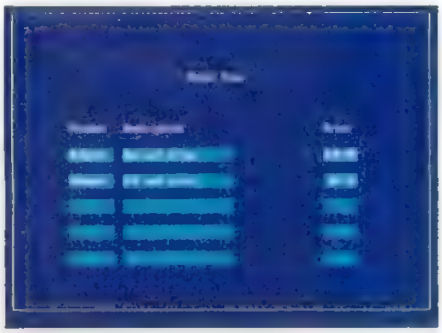
CIRCLE 293 ON READER SERVICE CARD

Sample Order Form



```
NPRODUCTS = 50          && however many products we have
dimension products(NPRODUCTS)
products( 1) = "Widgets , New and shiny , 20.00"
products( 2) = "Gadgets , Old and rusty ,  9.95"
        ...
products(50) = "Pizza   , No anchovies  , 12.50"
```

Figure 8: **The openPopList() function shown in Figure 9 lets you display a pop-up list of selections when you click on any of the product fields shown above.**

ing control back to FoxPro.

FoxPro now has no statements to execute, so it looks in the keyboard buffer, where it finds a Tab. The Tab is processed, leaving the old field *and executing its VALID clause,* just as if you had left the field by pressing Tab on the real keyboard. Fox then looks for another key and finds F2 in the buffer. Because of the ON KEY LABEL statement in validGo, the F2 causes validGo to be executed *again,* this time with `forReal = .T.`

Since `forReal` is now true, the ELSE part of the IF is executed. The POP KEY command restores any previous ON KEY LABEL settings. Then you move to the destination field by resetting `_curobj`.

You may have noticed that although I just finished describing how it's preferable to avoid macros, I used one in the `on key label F2. . .` statement, and another in resetting `_curobj`. Sometimes it's necessary to use a macro after all!

When the ON KEY LABEL F2 statement in Figure 7 defines the action to be taken when F2 is pressed, the value of `nextobj` is known because you're in the validGo function. However, when Fox later processes this forced F2 and actually takes the action (do validGo with. . .), you're *outside* the validGo function, and the variable `nextobj` doesn't even exist as far as Fox is concerned! Therefore, you couldn't just say

```
on key label F2 do validGo
    with nextobj, .T.
```

because you'd get a "variable not found" error when Fox processed the F2. Instead, you say `&nextobj`, which forces `nextobj` to be evaluated while the F2 key action is being *defined* rather than when it is being *executed.*

For example, suppose `nextobj` originally contained the character string "phonenum." The macro expansion would generate the statement:

```
on key label F2 do validGo
    with "phonenum", .T.
```

This ensures that the value of `nextobj` will be known when the F2 key action is being taken.

You must use another macro to reassign `_curobj` because the function objnum() does not allow a name expression as an argument; you must give it a string corresponding to the actual name of the variable.

MORE VERSATILE POP-UP LISTS Two annoying things about FoxPro pop-up lists are (1) they waste three screen lines per pop-up, and (2) you can't edit your selection after it's made. The following technique, suggested by Sheryl Canter, a frequent contributor to *PC Magazine,* neatly solves both these problems.

Suppose you have five invoice lines arranged as shown in the screen shot in Figure 8. The lines start in column 10 of screen rows 10, 12, 14, 16, and 18. The technique described below will let you click on the product codes for any of the five invoice lines and bring up a pop-up list of selections. When you've made your selection from the pop-up list, all the product information will appear in the appropriate fields on that line. You can then edit the fields if desired.

The pop-up list is built from the array

OPENPOPLIST() FUNCTION

Complete Listing

```
function openPopList
    private j, fldname, row
    do case
        case _curobj = objnum(prod1)
            row = 11
        case _curobj = objnum(prod2)
            row = 13
        case _curobj = objnum(prod3)
            row = 15
        case _curobj = objnum(prod4)
            row = 17
        case _curobj = objnum(prod5)
            row = 19
    endcase
    define popup myList from row, 10 to row + 6, 45 scroll
    for j = 1 to NPRODUCTS
        define bar j of myList prompt products(j)
    endfor
    on selection popup myList do closePopList with prompt()
    activate popup myList
*end function openPopList
```

Figure 9: **The openPopList() function creates a pop-up list from the information in Figure 8.**

CLOSEPOPLIST() FUNCTION

Complete Listing

```
procedure closePopList
    parameters prompt
    private prod, descript, price, comma1, comma2
    prod = varRead()
    descript = "descript" + right(varRead(), 1)
    price = "price" + right(varRead(), 1)
    comma1 = at(",", prompt)
    comma2 = at(",", prompt, 2)
    replace (prod) with left(prompt, comma1 - 1) , ;
            (descript) with alltrim(substr(prompt, comma1 + 1, ;
                                           comma2 - comma1 - 1)) , ;
            (price) with val(substr(prompt, comma2 + 1))
    show get (prod)
    show get (descript)
    show get (price)
    deactivate popup myList
    release popup myList
*end procedure closePopList
```

Figure 10: **The closePopList() function parses the selection from the pop-up list, places the components in their respective fields, then closes the pop-up list. You can then edit the fields if you choose.**

containing product name, description, and price shown in the order form in Figure 8. Instead of defining separate pop-ups for `prod1. . .prod5`, one pop-up is shared. Whenever you click on any of the prod fields, the pop-up will appear right below it. Here's how you do it.

First, define all the fields as normal data entry fields in the Screen Builder and add the following WHEN expression to each of the prod fields:

```
openPopList()
```

This expression will be executed whenever you click on `prod1`, `prod2`, `prod3`, `prod4`, or `prod5`. The code for openPopList() is shown in Figure 9.

The function first checks which invoice line you're on to determine the row for displaying the pop-up. It then defines a pop-up called myList, which uses the row variable to position itself directly below the clicked field. (It displays a scroll bar if necessary.) Next, each of the lines in the pop-up list (called *bars* by FoxPro) is filled in from the products array. There are NPRODUCTS in all.

The `on selection` statement tells FoxPro what to do when a selection is made. In this case, the `closePopList()` function is called, which passes the current prompt string as a parameter. The prompt string will be the line selected from the pop-up. The `activate popup` statement actually displays the pop-up so you can make your selection. Once you've selected, the closePopList() function listed in Figure 10 is called.

When the closePopList() function is entered, varRead() will return the name of the screen field originally clicked on, namely `prod1` through `prod5`. The last character, 1 through 5, is picked off and used to create appropriate *descript* and *price* field names.

The two commas in the prompt string passed by the openPopList() function are then found, and the various pieces of the string are picked off, trimming blanks and converting numbers as necessary. Then the invoice line fields are replaced with the information from the prompt string, and `show get` commands are issued so the updates will be displayed. Finally, the pop-up is brought down by deactivating it and releasing its memory.

When the pop-up disappears, all three fields on the line will be updated, and the cursor will still be on `prod1`, `prod2`, `prod3`, `prod4`, or `prod5`, so you can edit the field after the selection is made. If you wanted to edit a prod field without making a selection, that's easy, too—just click on the field and press Esc when the pop-up appears.

Hopefully this article and the one that preceded it will help you exploit the full power of FoxPro, as well as find ways around some of its limitations. □

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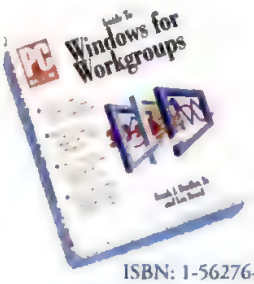

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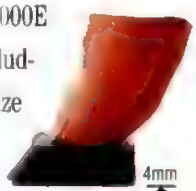

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CIRCLE 304 ON READER SERVICE CARD

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CIRCLE 272 ON READER SERVICE CARD

Launch Your Applications the Easy Way with BTNGO

BY JOHN DEURBROUCK

Has your Program Manager screen become so cluttered that you must double-click on a group and then double-click on an icon just to launch one of your most often-used applications? If so, this issue's free utility, BTNGO (for ButtonGo), will provide you with a convenient alternative.

BTNGO lets you set up a button bar that displays the icons of just the programs you run most frequently. All you have to do is click once on any button, and the program is launched. BTNGO uses the Program Manager's facilities to create the icon group. Under Windows 3.1, the utility's button bar can even float above other Windows applications, so you don't have to return to the Program Manager in order to switch to another program. BTNGO is also compatible with Windows 3.0, with some limitations, which will be discussed in the course of this article.

You can get an executable copy of BTNGO, together with its C++ source files, by downloading the file BTNGO.ZIP from PC MagNet's Utilities/Tips Forum. The details are explained in the sidebar "PC MagNet: Utilities and More." The source code is compatible with both Borland C++ 3.1 and Visual C++ 1.0, though if you need to produce a Windows 3.0-compatible executable, you must use the Borland rather than the Microsoft compiler.

If you don't have a modem, you can still get the BTNGO files, without charge, directly from *PC Magazine*. Just send a postcard with your name, address, and disk preference (1.2MB or 1.44MB) to the attention of Katherine West, *PC Magazine*, One Park Ave., New York, NY 10016-5802. No phone calls, please!

INSTALLING AND USING BTNGO After copying BTNGO onto your hard disk, you can get a quick idea of how the utility works by using the Program Manager's File | Run command. When started in this way, BTNGO brings up a dialog box that allows you to choose an already-established Program Manager group (.GRP) file to load. Select one of these, click OK, and BTNGO will transform the group into a button bar. A single (or double) click on a BTNGO button will then launch the corresponding program.

BTNGO's one-click launching can replace a crowded Program Manager's multichoice selection process when you want to start your favorite applications.

Group filenames can be somewhat cryptic. It's a good guess that your Accessories group has the default filename of ACCESSOR.GRP, but it may not. One way to check is through Program Manager. If the desired group is opened, you must first minimize it. Then select File | Properties (or, in Windows 3.1, hit Alt-Enter). The dialog box that is displayed shows both the group's name (for example, Accessories) and the filename (for example, C:\WINDOWS\ACCESSOR.GRP). Use the filename you find to create the ButtonGo button bar.

You'll notice that BTNGO's caption bar normally displays ButtonGo and the name of the group file you've loaded. If you click and hold down the left mouse button on any BTNGO button, however, the caption will change to show both the name you've given that program icon and the executable filename. For example, the README.WRI file in Windows' Main group will be displayed as "Read Me (README.WRI)." If you don't want to activate a button you've pressed, just drag the pointer off the button bar before letting up the mouse button.

While holding down the left mouse button, you can also drag the mouse pointer over other buttons and see their names on the caption bar. This is important when you have duplicate icons. You might, for example, have several Notepad icons, each of which opens a different file. Holding down the left mouse button in this case will tell you which file will be opened. Because BTNGO uses group files, you can use Program Manager to modify your icons and names so they work well for you on the title bar. But if you make a change in Program Manager, you'll have to restart BTNGO be-

Top 10 Utilities

Rank	Utility
1	**DIRMATCH** - *Compares directories*
2	**BAT2EXEC** - *Compiles batch files*
3	**BUGS** - *Windows 3.1 screen saver*
4	**CHKFRAG** - *Checks fragmentation*
5	**INCTRL** - *Installation control*
6	**PCSPOOL** - *Print spooler*
7	**CLIPST** - *Extends the clipboard*
8	**DEFRAGER** - *Defragments disks*
9	**WINCMD** - *Command file interpreter*
10	**CHANGER** - *Varies Windows' look*

This list is based on the total number of downloads each utility has had on PC MagNet over the past 12 months. To download these files, type GO ZNT:TIPS. For more information, see the sidebar "PC MagNet: Utilities and More."

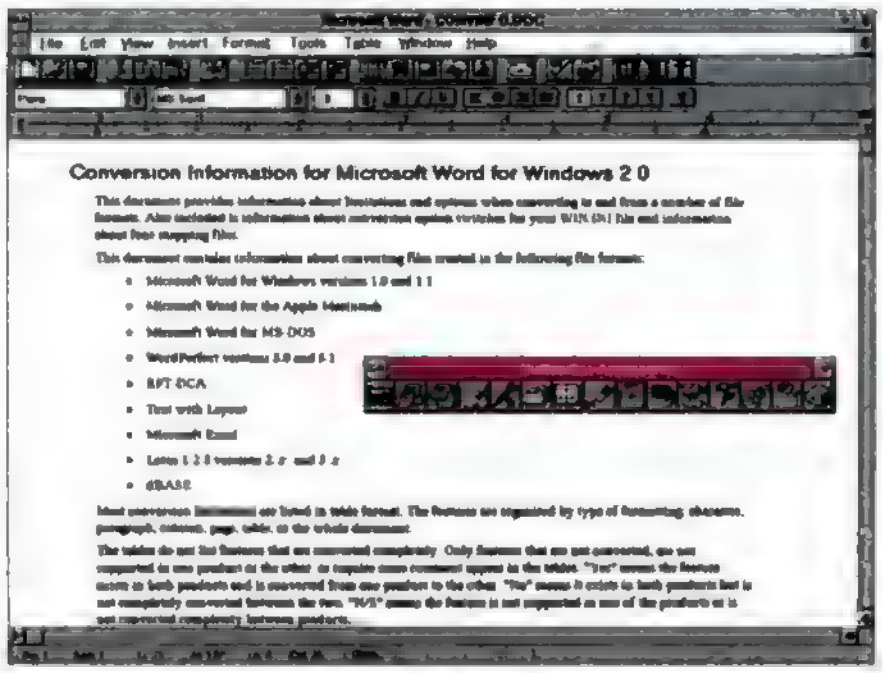

***Figure 1:* When you run it under Windows 3.1 or later, by default the BTNGO utility displays itself as this topmost window.**

fore you'll see the change.

To create your own Program Manager group for BTNGO, select File | New, click on Program Group, and then click on OK. Give the new group a description and a filename and click OK again. Next, hold down the Ctrl key and drag the icons for the programs you want on your button bar into your new group. By holding down the Ctrl key in this step, you make *copies* of your icons. This allows you to take advantage of BTNGO without disturbing your original group organization.

You can also create an *association* between BTNGO and the .GRP extension. To do this, open the File Manager and select File | Associate. Type GRP in the Files with Extension field, then type in the fully qualified application name (for example, C:\UTILS\BTNGO.EXE). In Windows 3.1, you can click the Browse button to open the Browse dialog box, select BTNGO.EXE and click OK, then click OK again. Double-clicking on a .GRP file in the File Manager will now bring up that group as a BTNGO button bar. You'll now also be able to drag a .GRP filename from File Manager right into a Program Manager group. The BTNGO icon will appear, and double-clicking on it will produce a button bar for that group.

Once an association between BTNGO and the .GRP extension has been created, it becomes easy to automatically start BTNGO each time you enter Windows. Simply add the name of a group file to a RUN= line in the [Windows] section of WIN.INI (for example, RUN=C:\WINDOWS\UTILS.GRP), or if you're running Windows 3.1, add the .GRP file you want to your Startup group.

You can bypass the Choose .GRP file dialog box by specifying a group file when you start BTNGO. Indeed, under Windows 3.0, you *must* explicitly name a .GRP file on the command line unless one of your applications has installed the COMMDLG.DLL file on your system or you've created an association in the manner described above. For example, entering the following line:

```
C:\UTILS\BTNGO C:\WINDOWS\MAIN.GRP
```

in the Program Manager File | Run dialog box will display the button bar immediately. If you specify this command on the Program Item Properties command line, you won't have to select the group file each time the program starts.

As you maintain your group files, you will want to be careful that they don't get too large if you intend to use them with BTNGO. Since the button bar arranges all its icons side by side, a group with too many icons will extend off the screen and some icons may not even appear. You can avoid this problem by breaking larger groups you want to use with BTNGO into smaller ones.

When running under Windows 3.1 or later, BTNGO defaults to displaying itself as a topmost window, as shown in Figure 1. In this way, like the Windows Clock accessory, BTNGO can remain visible even when a full-screen application is in use. If you find this inconvenient, you simply need to uncheck the Always On Top option in BTNGO's system menu. BTNGO stores this preference—along with the last place on the screen where you put your button bar—in a private BTNGO.INI file that is created automatically in the same directory that contains BTNGO.EXE.

▪ The Take Command of Windows Contest

PC Magazine and ZiffNet challenge you to take command of your Windows environment and win a Sony Discman. WINCMD is a *PC Magazine* utility that lets you create simple Windows batch programs. Write a script that automates a Windows operation and enter it in the Take Command of Windows Contest. The script that's most original and useful will win. The winner will receive a Sony Discman portable CD player plus a Gift Bag containing a *PC Magazine* black satin racing jacket and various ZiffNet goodies. Three runners-up will also be chosen and will each receive a Gift Bag. All entries will be judged by Contributing Editor Douglas Boling (WINCMD's author).

To obtain the official entry form, rules, and program files, download ENTER.TXT, WINCMD.EXE, and its function library, WCLIB.WCL, from *PC Magazine*'s Utilities/Tips Forum (GO ZNT:TIPS), in the PC Mag Utils Library (Lib 2). If you don't have a modem, you can request the form, rules, and files by mail or phone: Send a postcard to WINCMD Contest, *PC Magazine,* One Park Ave., New York, NY 10016-5802, or call 212-503-4550. (WINCMD was published in the April 27, 1993, issue; WCLIB.WCL, was published in the May 25, 1993, issue.)

You can submit your WINCMD script electronically by uploading your entry via ZiffNet to 72241,104, or you can mail your entry on a 3.5- or 5.25-inch high-density disk to WINCMD Contest, *PC Magazine,* One Park Ave., New York, NY 10016-5802.

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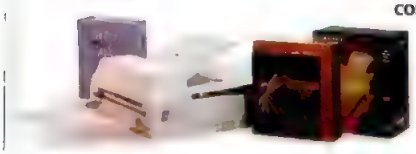

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CIRCLE 179 ON READER SERVICE CARD

Painting the Button Bar

Partial Listing

```
case WM_PAINT:
    {
        PAINTSTRUCT ps;
        HDC hdc=BeginPaint(hwnd,&ps);
        if(hdc!=NULL){
            HDC hdcmem=CreateCompatibleDC(hdc);
            if(hdcmem!=NULL){
                HBITMAP hbmOld=SelectObject(hdcmem,hbmNow);
                get_right_bitmap(hdcmem);
                BitBlt(hdc,0,0,bitmap_width,bitmap_height,hdcmem,0,0,SRCCOPY);
                SelectObject(hdcmem,hbmOld);
                DeleteDC(hdcmem);
            }
        }
        EndPaint(hwnd,&ps);
    }
    return 0;
```

Figure 2: **This code fragment, in conjunction with the get_right_bitmap() function in Figure 3, paints the button bar. It saves the original bitmap and uses SelectObject() to select the scratch bitmap (hbmNow). Note that hbmOld is selected back into hdcmem before that device context is deleted.**

If you look inside BTNGO.INI, you'll see that there is a section for each group file you've used with BTNGO. This allows you, for example, to keep your Main group displayed permanently atop other windows and aligned in the lower-right corner of your screen, while your Accessories group might be in the center of the screen and not float above other windows.

Notice that BTNGO.INI uses the fully qualified pathname for each group file as a section header. This enables BTNGO to operate independently of Program Manager. Program Manager displays only the group files named in PROGMAN.INI. Once a .GRP file is created, however, BTNGO can use it even if Program Manager doesn't know about it. Thus, for example, if you manually remove all references to MAIN.GRP from PROGMAN.INI, the Main group will no longer be displayed in the Program Manager. But BTNGO will still be able to open MAIN.GRP, and will retain your Always On Top and location preferences from session to session.

BTNGO's independence from Program Manager can create one minor integration problem. For example, if you make changes to your Main group in Program Manager and then load MAIN .GRP into BTNGO, you may find that the new arrangement is not reflected on the button bar. This is because Program Manager doesn't necessarily write to the .GRP file until you exit Windows. Windows will rewrite the .GRP file immediately after some changes, but not after others.

With Windows 3.1, you can force Program Manager to update the group files with a little trick. Just hold down the Shift key while you select Program Manager's File | Exit Windows command with either the keyboard or the mouse. This won't cause you to exit Windows, but it will cause the Program Manager to update the group files! If you do this after you've made changes and then launch BTNGO, your button bar will have the correct contents.

One important caution is in order: Don't edit PROGMAN.INI from within Windows. To add or remove group file names in PROGMAN.INI, always exit to the DOS prompt and use a DOS text editor to make the changes in PROGMAN .INI, then restart Windows. Otherwise, your changes may be overwritten or the .INI file may become corrupted.

Removing BTNGO from your system is easy: Just delete BTNGO.EXE and BTNGO.INI. BTNGO doesn't create or modify any other files.

PROGRAMMING CONSIDERATIONS I had several design goals in mind while writing BTNGO. I wanted it to be compatible with Windows 3.0 and later, and I wanted it to be as frugal with system resources as possible. I also wanted to ensure that each button bar was at least partially visible on-screen, rather than blindly placed at previous coordinates. And I wanted the source code compatible with the current Microsoft and Borland compilers.

Compatibility with Windows 3.0 presented minimal difficulty. I did, however, want to take advantage of the Common Dialog library (COMMDLG.DLL), which is distributed with Windows 3.1.

If Statement

Complete Listing

```
void get_right_bitmap(HDC hdc){
    HDC hdc_source;
    HBITMAP hbmOld;
    if(!mouse_down||mouse_button_number==-1||
    !bitmap_width||!actual_buttons||
    (0==(hdc_source=CreateCompatibleDC(hdc)))){
        // just poke in the 'Up' bitmap
        SelectObject(hdc,hbmUp);
    }
    else{
        int left_edge=mouse_button_number*BUTTON_WIDTH;
        // first draw all 'up' buttons
        hbmOld=SelectObject(hdc_source,hbmUp);
        BitBlt(hdc,0,0,bitmap_width,bitmap_height,hdc_source,0,0,SRCCOPY);
        // now poke in the single 'down' button
        SelectObject(hdc_source,hbmDown);
        BitBlt(hdc,left_edge,0,BUTTON_WIDTH,bitmap_height,
                    hdc_source,left_edge,0,SRCCOPY);
        SelectObject(hdc_source,hbmOld);
        DeleteDC(hdc_source);
    }
}
```

Figure 3: **This if statement says: If the mouse button is up, or if the mouse pointer is not on a button, or if we don't have any buttons at all, we'll simply paint the default all-up button bar. Otherwise, we first copy the up map into the scratch bitmap, then copy the appropriate down button into its correct place. At this point we've created a total of three device contexts, but we'll release them all right away.**

Windows 3.0 users *may* also have this file, since it is distributed with many applications. But for 3.0 users without this DLL, I wanted to handle the situation gracefully instead of letting them get a cryptic "Can't find COMMDLG.DLL" message. Therefore, rather than calling GetOpenFileName() directly, I used LoadLibrary() and GetProcAddress() to call the function. This let me trap the case where COMMDLG.DLL wasn't available so I could handle it with appropriate user instructions.

I worked in several areas to keep system resource usage to a minimum. I wanted to minimize the number of controls created, so I implemented the button bar itself as nothing more than a bitmap painted onto the ButtonGo window's client area. Here's how BTNGO does it:

First, BTNGO reads the entire .GRP file's contents into memory. (To learn more about .GRP files, see the Utilities column on WINTIDY in the January 12, 1993, issue of *PC Magazine*.) Each icon displayed in a group has information associated with it—the item's name, the coordinates of the icon within the group, and so on. Since the entries aren't necessarily in the order in which they will appear in the group's window, they are then sorted by their coordinates.

The next step is to create a display-compatible bitmap large enough to hold all the icons in the group file. BTNGO copies all the icons from the group file into the bitmap and then draws lines around each icon. The lines make each icon look like a button in the up position. This entire bitmap, when displayed, is the button bar in its normal state.

Another bitmap is then created, this time copying all the icons at 80 percent of their original size with StretchBlt(). The lines drawn around each icon suggest a button in the down position. If this bitmap were to be displayed, it would look as if all the buttons were depressed.

One last bitmap is then created for use during actual screen painting. As shown in Figure 2, this scratch bitmap is created and kept on hand from the outset to improve performance.

Normally when BTNGO repaints its window, it simply uses BitBlt() to copy the entire up bitmap to the client area.

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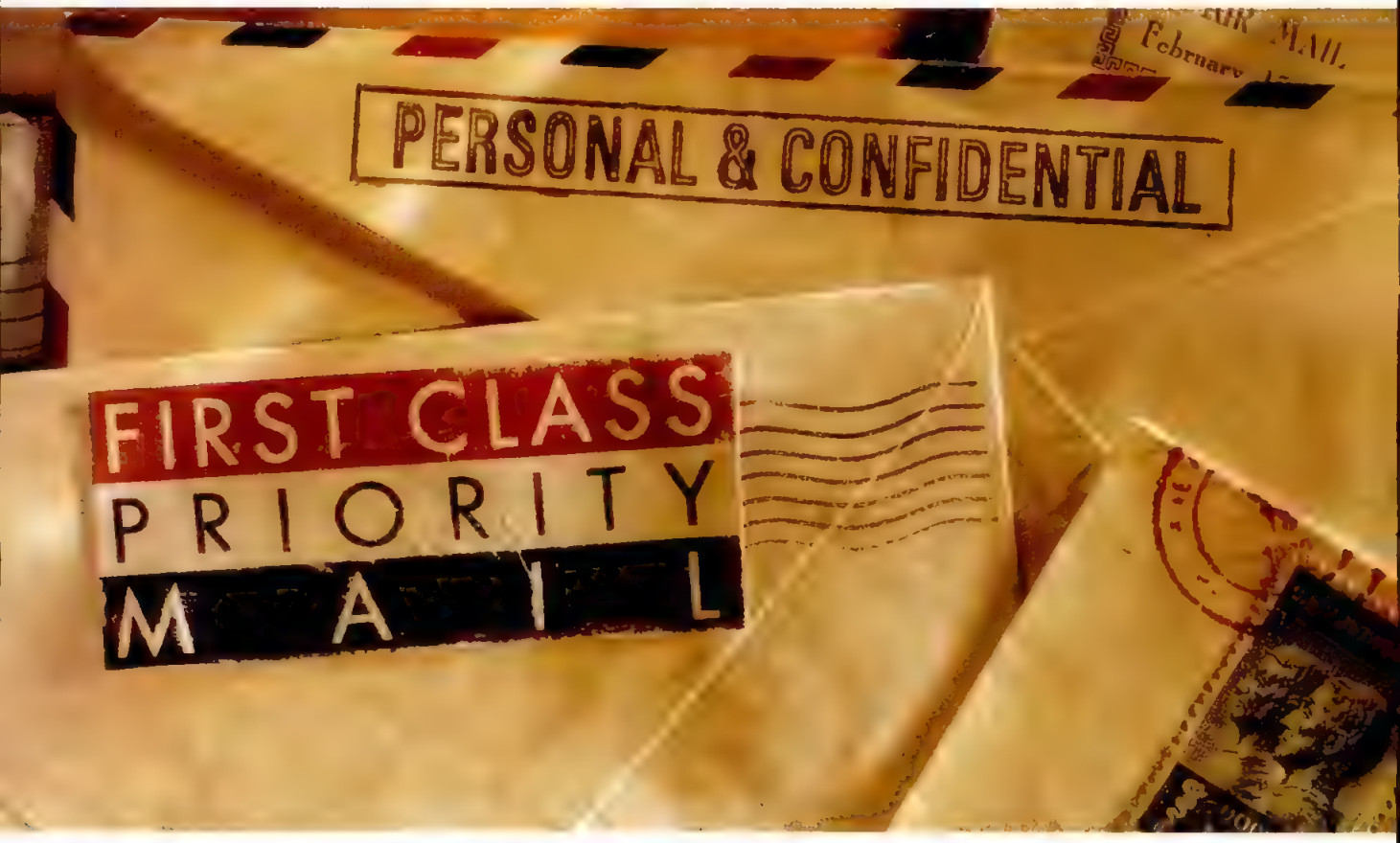

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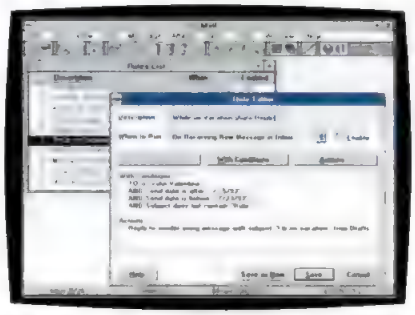

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To create the visual impression of a button being pushed down, BTNGO goes through three steps. First, the up bitmap is copied onto the scratch bitmap. Then a rectangular portion of the down bitmap corresponding to the depressed button is copied onto the appropriate part of the scratch bitmap. Finally, the scratch bitmap is displayed in the client area of the window. The entire process, shown in Figure 3, is fast enough to keep up with user interaction, and is economical in terms of system resources because there aren't icon or window handles for each of the apparent controls.

Once the bitmaps have been created and the string data (application title, default path, and so on) for each of the entries in the group file has been saved, the memory allocated to read the .GRP file is released. This reduces BTNGO's impact on free system memory.

BTNGO comprises just under 1,500 lines of code, but it still demonstrates some interesting aspects of Windows programming.

Like Windows' Clock accessory, BTNGO can remember where its window was last placed on the desktop. But Clock has an irritating feature that BTNGO avoids: Clock will put its window at its last coordinates even if those coordinates are off the screen! If you doubt this, just put your system into 1,024-by-768 mode and put the clock in the lower-right-hand corner. Then switch to a 640-by-480 driver (which I do often, to get 24-bit color), start the clock, and it's gone—its window is somewhere to the lower right of your screen, perhaps next to your coffee cup. BTNGO won't do that. When choosing its screen location, Windows' default positioning is used unless the user's preferred location leaves at least part of the ButtonGo title bar on-screen.

There was one roadblock I came to in developing the utility. While making BTNGO compatible with both Borland C++ 3.1 and Visual C++ 1.0, I was entirely unable to produce a Windows 3.0-compatible executable with the Microsoft product. Simply loading the program causes a general protection fault, and several conversations with Microsoft yielded no solution. The only workaround was to use Borland C++ to make the distribution version. The Visual C++ version works fine under Windows 3.1.

BTNGO was written in C++; I didn't use MFC (Microsoft Foundation Classes) or OWL (Object Windows Library—Borland's application framework). I wrote a little class, WinMessageString, to handle screen output. For this class, I overloaded the insertion operator (<<) to do screen output. I wrote an operator<< function to display the int, long, unsigned int, and char * types. BTNGO uses the small memory model, and I wanted to write separate functions for passing near and far pointers and to do the conversion explicitly. This meant adding an operator<< function for a char _far * type. However, the Borland compiler wouldn't accept this, so if _BORLANDC_ is defined when BTNGO is being compiled, I implement only the _far version and let the compiler do the conversion implicitly.

BTNGO comprises just under 1,500 lines of code, but it still demonstrates some interesting aspects of Windows programming. It's worth noting that porting the entire project from one compiler to another required only the simple change mentioned above. Even in the absence of a formal C++ standard, it *is* possible to maintain source compatibility across compilers by staying away from proprietary or new features such as MFC, OWL, and templates.

Once you've taken the time to set up your groups the way you like them, Program Manager is used mostly as a large, clumsy program launcher. You have to hunt for the programs you use most often, and if you move the mouse too much during the double click, Program Manager will fail to start the program and will also mess up your careful icon arrangement. BTNGO eliminates such hassles, and that's the test for a worthwhile utility. □

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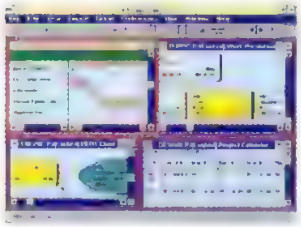

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Multithreading and Graphics Under Windows NT

BY CHARLES PETZOLD

On October 3, 1986, Microsoft held a day-long press briefing for technical editors and writers of computer magazines to discuss its current array of language products, including its first interactive development environment, QuickBASIC 2.0. At that time Windows 1.0 was less than a year old, and no one knew when we'd get something similar for that environment.

What made this event unique was a little something that Microsoft's public relations folks had cooked up—a programming contest called "Storm the Gates." Bill Gates would be using QuickBASIC, and the technical computer press people could use whatever language products they might decide to bring. As Stephen Manes and Paul Andrews wrote in their delightful biography of Gates, this "was as if Lee Iacocca had agreed to race in a Chrysler New Yorker against any car an automotive journalist might show up with."

THE PROGRAMMING CONTEST PROBLEM The particular programming problem used for the contest was picked out of a hat from among several others (designed to require about half an hour to program) submitted by the press contestants. It went something like this:

Create a multitasking simulation consisting of four windows. The first window must show a series of increasing numbers, the second must show a series of increasing prime numbers, and the third must show the Fibonacci series. (The Fibonacci series begins with the numbers 0 and 1, and every successive number is the sum of the two before it, that is, 0, 1, 1, 2, 3, 5, 8, and so forth). These three windows should either scroll or clear themselves when the numbers reach the bottom of the window. The fourth window must display circles of random radii, and the program must terminate with a press of the Esc key.

Of course, in October, 1986, such a program running under DOS couldn't be much more than a multitasking simulation, and none of the contestants were brave enough—and most not yet knowledgeable enough—to code it for Windows. Moreover, to do so from scratch would almost certainly have taken much longer than half an hour!

Reviving a seven-year-old programming problem—and solving it anew—provides a good way to explore multithreading under Windows NT.

Most of the people who participated in this contest wrote a program that divided the screen into four areas. The program contained a loop that sequentially updated each window and then checked if the Esc key had been pressed. As is customary under DOS, the program used 100 percent of CPU processing.

NOW FOR THE FIRST TIME... As we begin to explore the multithreading support of Windows NT, reviving this seven-year-old programming problem for some illustrative code has a certain historial resonance. So now, for the first time anywhere, let's do it in Windows.

Under Windows—that is, the DOS-based version of Windows—such a program simply cannot sit in a loop and update the display. To do so would essentially shut down the rest of the system until the program was terminated. A more reasonable solution is to use the Windows timer. On each receipt of a WM_TIMER message, the program updates the four windows.

Although a Windows program could simply divide its client area into four sections for displaying the four elements of output, Windows provides another solution to the windowing part of this programming problem: child windows. The main window creates four child windows, each of which is devoted to only one job.

Figures 1 and 2 show the make file and C source code file for a solution to this programming problem under Windows NT using the Windows timer. The MULTI1 program could easily be adapted for compilation under Windows 3.1. (One thing that needs to be changed for Windows 3.1 is the definition of the wParam variable to the window procedures. Under Windows 3.1, wParam is a 16-bit word, but under Windows NT it's a 32-bit double word. In addition, you would probably want to change the definition of the displayed numbers from integers to long integers.)

As I discussed in the last issue, make files for Windows NT are generally constructed using macro variables defined in NTWIN32.MAK for the compiler name, compiler flags, compiler variables, linker name, linker flags, and libraries. This lets you use the same make file when compiling and linking the program for processors other than the Intel 386 and 486. The MULTI1.MAK file shows the normal format for a nonmultithreaded graphical application under Windows NT.

CHILD WINDOWS As Windows programs normally do, MULTI1 starts off in its WinMain function by creating a main window for the program. The window procedure for this main window is Wnd-

MULTI1.MAK
Complete Listing

```
#----------------------
# MULTI1.MAK make file
#----------------------

!include <ntwin32.mak>

multi1.exe : multi1.obj
    $(link) $(guiflags) -out:multi1.exe multi1.obj $(guilibs)

multi1.obj : multi1.c
    $(cc) $(cflags) $(cvars) multi1.c
```

Figure 1: **This make file facilitates compilation of the MULTI1 program.**

ProcMain, located at the end of MULTI1.C.

During creation of the main window, WndProcMain performs several different functions. First it registers four window classes with the names Child1, Child2, and so forth. These four window classes are associated with the window procedures named WndProc1, WndProc2, and so on. (These procedures are located earlier in the program.) The WndProcMain procedure also creates four child windows that are based on these four window classes. Initially, each of these windows has a height and width of zero.

After creating the four windows, WndProcMain finds the height of the system font character by calling GetDialogBaseUnits, and stores the result in a global variable. The WM_CREATE processing concludes when WndProcMain sets the Windows NT timer with an interval of 10 milliseconds. This is a smaller time interval than the system clock, so WndProcMain will receive a WM_TIMER message during each system clock tick.

The sizing of the child windows occurs in WndProcMain during the WM_SIZE message. WndProcMain simply gets the width and height of its own client area, and then (using the MoveWindow function) positions and sizes each of the four child windows to occupy four quadrants of the main window client area.

During the WM_TIMER message, WndProcMain sends the message on to each of the four child windows. This allows the four child windows to update themselves.

As I mentioned, the specifications of this programming problem also required that the program be terminated with a press of the Esc key. Of course, this is not normal for a Windows program, but I felt obligated to add that feature. During the WM_CHAR message, WndProcMain checks if the character code is '\x1B' and, if so, calls DestroyWindow. As the window is destroyed, all the child windows are destroyed also. During the WM_DESTROY message, WndProcMain calls KillTimer to stop the timer messages.

The WndProc1, WndProc2, WndProc3, and WndProc4 functions are the window procedures for each of the four child windows. They each process just two messages—WM_SIZE and WM_TIMER. The window procedures receive the WM_SIZE message when the child window is first created and, later on, when the WndProcMain processes its own WM_SIZE message by calling the MoveWindow function.

The child window procedures receive the WM_TIMER message sent by WndProcMain. Of course each child window could set its own timer (and indeed, an early version of the MULTI1 program did just that), but using one timer for all four windows reduced the code bulk and the drain on system resources in one stroke.

The processing of the WM_TIMER message in the first three child window procedures is quite similar because each of these windows displays various sequences of numbers running down the window. WndProc1 is, of course, the simplest because it need only display increasing numbers beginning with zero. It uses wsprintf to format the number in a character string (in the process, incrementing it), obtains a handle to a device context for the window, and displays the number using TextOut.

Before displaying the number, however, the window procedure performs a couple of checks. First, if the current number is negative (meaning that it's been incremented past 2,147,483,647), then it resets the number to zero.

Also, the window procedures call the function in MULTI1.C that is called CheckBottom. The function checks if the display has reached the bottom of the window, at which time it calls the InvalidateRect and UpdateWindow functions. This causes the window procedure to receive WM_ERASEBKGND (erase background) and WM_PAINT messages. WndProc1 processes neither of these messages, but simply passes them on to DefWindowProc for default processing. This simply erases the contents of the window.

(Normally a Windows program should maintain enough information to recreate the contents of its window during the WM_PAINT message. MULTI1 doesn't do this, but the windows are drawn and erased so rapidly that I didn't think it necessary.)

The prime number generator in WndProc2 isn't terribly efficient, but it works. A number is prime, of course, if it has no divisors except 1 and itself. To check if a particular number is prime, however, doesn't require dividing by all numbers and checking for remainders up to the number being checked, but only up to the square root of that number. That square root calculation is the reason for the unusual introduction of floating-point math in an otherwise all integer-based program.

WHAT'S WRONG WITH IT? There is nothing really wrong with the MULTI1 program. Using the Windows timer is a fine way to simulate multitasking under the DOS-based version of Windows and Windows NT.

However, the use of the timer sometimes restricts the speed of a program. If the program can update all its windows within a single WM_TIMER message with time to spare, then it's not taking full advantage of the machine.

One possible solution is to perform two or more updates during a single WM_TIMER message. But how many?

MULTI1.C

1 of 2

```
/*----------------------------------------
   MULTI1.C -- Multitasking Demo
               (c) Charles Petzold, 1993
  ----------------------------------------*/

#include <windows.h>
#include <stdlib.h>
#include <string.h>
#include <math.h>

LONG APIENTRY WndProcMain (HWND, UINT, DWORD, LONG) ;

short cyChar ;

int PASCAL WinMain (HANDLE hInstance, HANDLE hPrevInstance,
                    LPSTR lpszCmdParam, int nCmdShow)
     {
     static char szAppName[] = "Multi1" ;
     HWND        hwnd ;
     MSG         msg ;
     WNDCLASS    wndclass ;

     wndclass.style         = CS_HREDRAW | CS_VREDRAW ;
     wndclass.lpfnWndProc   = WndProcMain ;
     wndclass.cbClsExtra    = 0 ;
     wndclass.cbWndExtra    = 0 ;
     wndclass.hInstance     = hInstance ;
     wndclass.hIcon         = LoadIcon (NULL, IDI_APPLICATION) ;
     wndclass.hCursor       = LoadCursor (NULL, IDC_ARROW) ;
     wndclass.hbrBackground = GetStockObject (WHITE_BRUSH) ;
     wndclass.lpszMenuName  = NULL ;
     wndclass.lpszClassName = szAppName ;

     RegisterClass (&wndclass) ;

     hwnd = CreateWindow (szAppName, "Multitasking Demo",
                          WS_OVERLAPPEDWINDOW,
                          CW_USEDEFAULT, CW_USEDEFAULT,
                          CW_USEDEFAULT, CW_USEDEFAULT,
                          NULL, NULL, hInstance, NULL) ;

     ShowWindow (hwnd, nCmdShow) ;
     UpdateWindow (hwnd) ;

     while (GetMessage (&msg, NULL, 0, 0))
          {
          TranslateMessage (&msg) ;
          DispatchMessage (&msg) ;
          }
     return msg.wParam ;
     }

int CheckBottom (HWND hwnd, int cyClient, int iLine)
     {
     if (iLine * cyChar + cyChar > cyClient)
          {
          InvalidateRect (hwnd, NULL, TRUE) ;
          UpdateWindow (hwnd) ;
          iLine = 0 ;
          }
     return iLine ;
     }

// Window 1: Display increasing sequence of numbers
// ------------------------------------------------

LONG APIENTRY WndProc1 (HWND hwnd, UINT message, DWORD wParam, LONG lParam)
     {
     static int   iNum, iLine ;
     static short cyClient ;
     char         szBuffer [16] ;
     HDC          hdc ;

     switch (message)
          {
          case WM_SIZE:
               cyClient = HIWORD (lParam) ;
               return 0 ;

          case WM_TIMER:
               if (iNum < 0)
                    iNum = 0 ;

               iLine = CheckBottom (hwnd, cyClient, iLine) ;

               wsprintf (szBuffer, "%d", iNum++) ;

               hdc = GetDC (hwnd) ;
               TextOut (hdc, 0, iLine * cyChar, szBuffer, strlen (szBuffer)) ;

               ReleaseDC (hwnd, hdc) ;

               iLine++ ;

               return 0 ;
          }
     return DefWindowProc (hwnd, message, wParam, lParam) ;
     }

// Window 2: Display increasing sequence of prime numbers
// ------------------------------------------------------

LONG APIENTRY WndProc2 (HWND hwnd, UINT message, DWORD wParam, LONG lParam)
     {
     static int   iNum = 1, iLine ;
     static short cyClient ;
     char         szBuffer [16] ;
     int          i, iSqrt ;
     HDC          hdc ;

     switch (message)
          {
          case WM_SIZE:
               cyClient = HIWORD (lParam) ;
               return 0 ;

          case WM_TIMER:
               do   {
                    if (++iNum < 0)
                         iNum = 0 ;

                    iSqrt = (int) sqrt (iNum) ;

                    for (i = 2 ; i <= iSqrt ; i++)
                         if (iNum % i == 0)
                              break ;
                    }
               while (i <= iSqrt) ;

               iLine = CheckBottom (hwnd, cyClient, iLine) ;

               wsprintf (szBuffer, "%d", iNum) ;

               hdc = GetDC (hwnd) ;
               TextOut (hdc, 0, iLine * cyChar, szBuffer, strlen (szBuffer)) ;

               ReleaseDC (hwnd, hdc) ;

               iLine++ ;

               return 0 ;
          }
     return DefWindowProc (hwnd, message, wParam, lParam) ;
     }

// Window 3  Display increasing sequence of Fibonacci numbers
// ----------------------------------------------------------

LONG APIENTRY WndProc3 (HWND hwnd, UINT message, DWORD wParam, LONG lParam)
     {
     static int   iNum = 0, iNext = 1, iLine ;
     static short cyClient ;
     char         szBuffer [16] ;
     int          iTemp ;
     HDC          hdc ;

     switch (message)
          {
          case WM_SIZE:
               cyClient = HIWORD (lParam) ;
               return 0 ;

          case WM_TIMER:
               if (iNum < 0)
                    {
                    iNum  = 0 ;
                    iNext = 1 ;
                    }

               iLine = CheckBottom (hwnd, cyClient, iLine) ;

               wsprintf (szBuffer, "%d", iNum) ;

               hdc = GetDC (hwnd) ;
               TextOut (hdc, 0, iLine * cyChar, szBuffer, strlen (szBuffer)) ;

               ReleaseDC (hwnd, hdc) ;

               iTemp  = iNum ;
               iNum   = iNext ;
               iNext += iTemp ;

               iLine++ ;

               return 0 ;
          }
     return DefWindowProc (hwnd, message, wParam, lParam) ;
     }

// Window 4: Display circles of random radii
// -----------------------------------------

LONG APIENTRY WndProc4 (HWND hwnd, UINT message, DWORD wParam, LONG lParam)
     {
     static short cxClient, cyClient ;
     HDC          hdc ;
     int          iDiameter ;
```

Figure 2: **This listing shows a solution to the programming problem using the Windows timer.**

MULTI1.C

2 of 2

```
    switch (message)
        {
        case WM_SIZE:
            cxClient = LOWORD (lParam) ;
            cyClient = HIWORD (lParam) ;
            return 0 ;

        case WM_TIMER:
            InvalidateRect (hwnd, NULL, TRUE) ;
            UpdateWindow (hwnd) ;

            iDiameter = rand() % min (cxClient, cyClient) ;

            hdc = GetDC (hwnd) ;

            Ellipse (hdc, (cxClient - iDiameter) / 2,
                          (cyClient - iDiameter) / 2,
                          (cxClient + iDiameter) / 2,
                          (cyClient + iDiameter) / 2) ;

            ReleaseDC (hwnd, hdc) ;
            return 0 ;
        }
    return DefWindowProc (hwnd, message, wParam, lParam) ;
    }

// Main window to create child windows
// -----------------------------------

LONG APIENTRY WndProcMain (HWND hwnd, UINT message, DWORD wParam, LONG lParam)

    {
    static char  * szChildClass  [] = { "Child1", "Child2",
                                        "Child3", "Child4" } ;
    static HWND    hwndChild [4] ;
    static WNDPROC lpfnChildProc [] = { WndProc1, WndProc2,
                                        WndProc3, WndProc4 } ;
    HINSTANCE      hInstance ;
    int            i ;
    short          cxClient, cyClient ;
    WNDCLASS       wndclass ;

    switch (message)
        {
        case WM_CREATE:
            hInstance = (HINSTANCE) GetWindowLong (hwnd, GWL_HINSTANCE) ;

            wndclass.style         = CS_HREDRAW | CS_VREDRAW ;
            wndclass.cbClsExtra    = 0 ;
            wndclass.cbWndExtra    = 0 ;
            wndclass.hInstance     = hInstance ;
            wndclass.hIcon         = NULL ;
            wndclass.hCursor       = LoadCursor (NULL, IDC_ARROW) ;
            wndclass.hbrBackground = GetStockObject (WHITE_BRUSH) ;
            wndclass.lpszMenuName  = NULL ;

            for (i = 0 ; i < 4 ; i++)
                {
                wndclass.lpfnWndProc   = lpfnChildProc [i] ;
                wndclass.lpszClassName = szChildClass [i] ;

                RegisterClass (&wndclass) ;

                hwndChild [i] = CreateWindow (szChildClass [i], NULL,
                    WS_CHILDWINDOW | WS_BORDER | WS_VISIBLE,

                    0, 0, 0, 0, hwnd, (HMENU) i, hInstance, NULL) ;
                }

            cyChar = HIWORD (GetDialogBaseUnits ()) ;
            SetTimer (hwnd, 1, 10, NULL) ;
            return 0 ;

        case WM_SIZE:
            cxClient = LOWORD (lParam) ;
            cyClient = HIWORD (lParam) ;

            for (i = 0 ; i < 4 ; i++)
                MoveWindow (hwndChild [i], (i % 2) * cxClient / 2,
                                           (i > 1) * cyClient / 2,
                            cxClient / 2, cyClient / 2, TRUE) ;
            return 0 ;

        case WM_TIMER:
            for (i = 0 ; i < 4 ; i++)
                SendMessage (hwndChild [i], WM_TIMER, wParam, lParam) ;

            return 0 ;

        case WM_CHAR:
            if (wParam == '\x1B')
                DestroyWindow (hwnd) ;

            return 0 ;

        case WM_DESTROY:
            KillTimer (hwnd, 1) ;
            PostQuitMessage (0) ;
            return 0 ;
        }
    return DefWindowProc (hwnd, message, wParam, lParam) ;
    }
```

That would have to depend on the speed of the machine, and that is a major variable. You would not want to write a program specifically tuned to a 25-MHz 386 or a 50-MHz 486.

Another solution is to abandon use of the Windows timer and move to a different approach. I mentioned earlier that DOS programs that solve this programming challenge simply sit in a loop and update the four windows, and that a Windows program cannot do this without halting the rest of the system.

Well, they actually can, with one important stipulation: that the program calls PeekMessage within the loop. This function effectively yields control to other programs if they need to process messages. But PeekMessage is almost always a bit of a kludge. The function basically exists to compensate for the nonpreemptive nature of multitasking under Windows.

With Windows NT another solution is possible, which is to use multiple threads of execution that run concurrently. One thread processes messages and other threads update the windows. These other threads can sit in infinite loops without any danger of halting the rest of the system.

THE MULTITHREADED SOLUTION Let's take a look at a multithreaded solution to this programming problem. The MULTI2 program is shown in Figures 3 and 4. (You can download both the MULTI1 and MULTI2 programs from the Programming Forum on PC MagNet, archived as MULTI.ZIP.) First notice that the make file is a bit different. The `cvars` macro variable is replaced by `cvarsmt` and the `guilibs` variable is replaced by `guilibsmt`. This is the normal format of a make file for a multithreaded graphical program.

The WinMain function and WndProcMain functions of MULTI2.C are very similar to those in MULTI1.C. WndProcMain registers four window classes for the four windows, creates those windows, and resizes them during the WM_SIZE message. The only difference in WndProcMain is that it no longer sets the Windows timer or processes WM_TIMER messages.

THREADS FOR DRAWING The main distinction of MULTI2 is that each of the child window procedures creates another thread of execution by calling the _beginthread() function (which I discussed in the last issue) during the WM_CREATE message.

In total, the MULTI2 program has five threads of execution that run concurrently. The main thread contains the main window procedure and the four child window procedures. The other four threads use the functions named Thread1, Thread2, and so forth. These other four threads are responsible for drawing the four windows.

The multithreaded code I showed in the last issue did not use the third parameter to _beginthread(). This parameter allows a thread that creates another thread to pass information to the other thread in 32-bit variables. Customarily, this variable is a pointer, and also custom-

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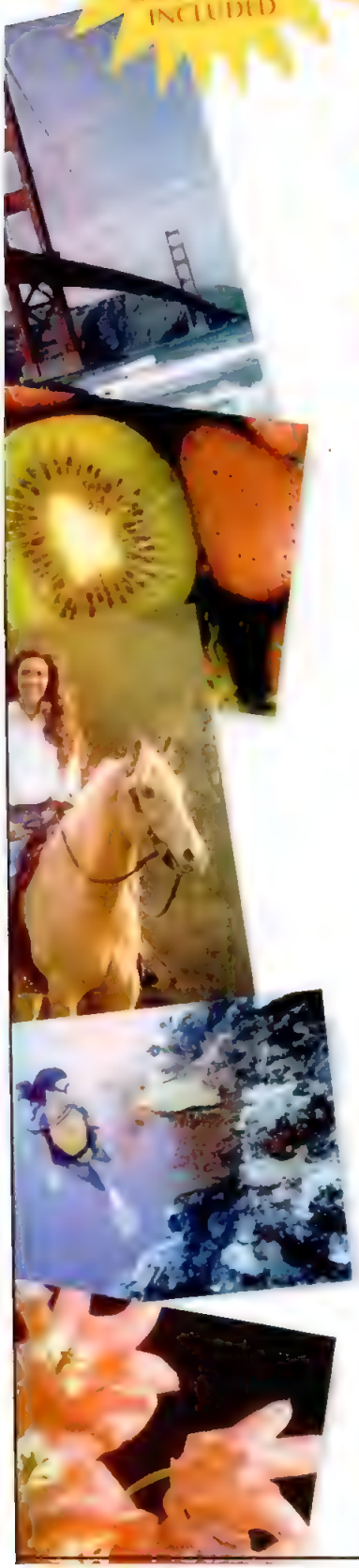

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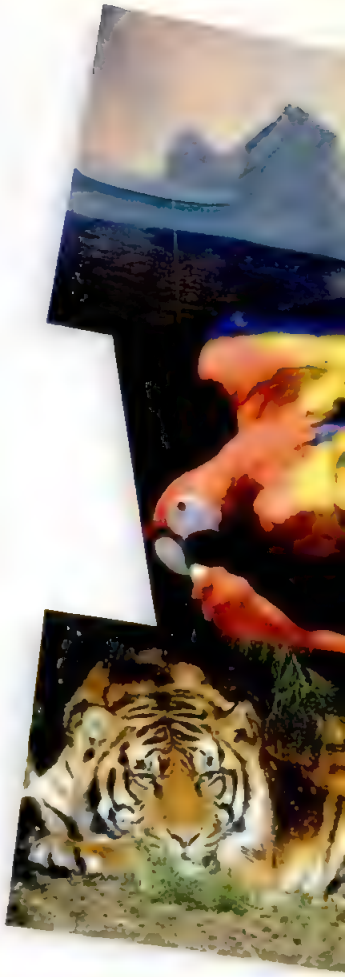

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MULTI2.MAK

Complete Listing

```
#----------------------
# MULTI2.MAK make file
#----------------------
!include <ntwin32.mak>
multi2.exe : multi2.obj
    $(link) $(guiflags) -out:multi2.exe multi2.obj $(guilibsmt)

multi2.obj : multi2.c
    $(cc) $(cflags) $(cvarsmt) multi2.c
```

Figure 3: **The make file to compile the MULTI2 program.**

arily, it is a pointer to a structure. This allows the creating thread and the new thread to share information without the use of global variables.

For the MULTI2 program I defined a structure named PARAMS near the top of the program, and a pointer to that structure named PPARAMS. This structure has four fields—a window handle, the width and height of the window, and a Boolean variable named bKill. This final structure field allows the creating thread to tell the created thread when it should terminate itself.

Let's take a look at WndProc1, the child window procedure that displays the sequence of increasing numbers. The window procedure has become very simple. The only local variable is a PARAMS structure. During the WM_CREATE message, it sets the hwnd field of this structure and calls _beginthread() to create a new thread using the Thread1 function, passing to it a pointer to this structure. During the WM_SIZE message, WndProc1 sets the cyClient field of the structure, and during the WM_DESTROY message, it sets the bKill field to TRUE.

The Thread1 function does the actual drawing on the window, and it runs concurrently with the other four threads of the program. The function receives a pointer to the PARAMS structure and runs in a while loop, checking each time if the bKill field is TRUE or FALSE. If TRUE, the function essentially performs the same processing as during the WM_TIMER message in MULTI1.C—formatting the number, obtaining a device context handle, and displaying the number using TextOut.

As you'll see when you run the MULTI2 program under Windows NT, the windows are updated much faster than in MULTI1, indicating that the program is using the power of the processor more efficiently.

There's another difference between MULTI1 and MULTI2: Usually when you move or size a window, the default window procedure enters a modal loop

MULTI2.C

1 of 2

```
/*----------------------------------------
   MULTI2.C -- Multitasking Demo
               (c) Charles Petzold, 1993
  ----------------------------------------*/

#include <windows.h>
#include <stdlib.h>
#include <string.h>
#include <math.h>
#include <process.h>

typedef struct
     {
     HWND  hwnd ;
     short cxClient ;
     short cyClient ;
     BOOL  bKill ;
     }
     PARAMS, * PPARAMS ;

LONG APIENTRY WndProcMain (HWND, UINT, DWORD, LONG) ;

short cyChar ;

int PASCAL WinMain (HANDLE hInstance, HANDLE hPrevInstance,
                    LPSTR lpszCmdParam, int nCmdShow)
     {
     static char szAppName[] = "Multi2" ;
     HWND        hwnd ;
     MSG         msg ;
     WNDCLASS    wndclass ;

     wndclass.style          = CS_HREDRAW | CS_VREDRAW ;
     wndclass.lpfnWndProc    = WndProcMain ;
     wndclass.cbClsExtra     = 0 ;
     wndclass.cbWndExtra     = 0 ;
     wndclass.hInstance      = hInstance ;
     wndclass.hIcon          = LoadIcon (NULL, IDI_APPLICATION) ;
     wndclass.hCursor        = LoadCursor (NULL, IDC_ARROW) ;
     wndclass.hbrBackground  = GetStockObject (WHITE_BRUSH) ;
     wndclass.lpszMenuName   = NULL ;
     wndclass.lpszClassName  = szAppName ;

     RegisterClass (&wndclass) ;

     hwnd = CreateWindow (szAppName, "Multitasking Demo",
                          WS_OVERLAPPEDWINDOW,
                          CW_USEDEFAULT, CW_USEDEFAULT,
                          CW_USEDEFAULT, CW_USEDEFAULT,
                          NULL, NULL, hInstance, NULL) ;

     ShowWindow (hwnd, nCmdShow) ;
     UpdateWindow (hwnd) ;

     while (GetMessage (&msg, NULL, 0, 0))
          {
          TranslateMessage (&msg) ;
          DispatchMessage (&msg) ;
          }
     return msg.wParam ;
     }

int CheckBottom (HWND hwnd, int cyClient, int iLine)
     {
     if (iLine * cyChar + cyChar > cyClient)
          {
          InvalidateRect (hwnd, NULL, TRUE) ;
          UpdateWindow (hwnd) ;
          iLine = 0 ;
          }
     return iLine ;
     }

// Window 1: Display increasing sequence of numbers
// -----------------------------------------------

void Thread1 (PPARAMS pparams)
     {
     int  iNum = 0, iLine = 0 ;
     char szBuffer [16] ;
     HDC  hdc ;

     while (!pparams->bKill)
          {
          if (iNum < 0)
               iNum = 0 ;

          iLine = CheckBottom (pparams->hwnd, pparams->cyClient, iLine) ;

          wsprintf (szBuffer, "%d", iNum++) ;

          hdc = GetDC (pparams->hwnd) ;
          TextOut (hdc, 0, iLine * cyChar, szBuffer, strlen (szBuffer)) ;
          ReleaseDC (pparams->hwnd, hdc) ;

          iLine++ ;
          }
     }

LONG APIENTRY WndProc1 (HWND hwnd, UINT message, DWORD wParam, LONG lParam)
     {
     static PARAMS params ;

     switch (message)
          {
          case WM_CREATE:
               params.hwnd = hwnd ;
               _beginthread (Thread1, 0, &params) ;
               return 0 ;

          case WM_SIZE:
               params.cyClient = HIWORD (lParam) ;
               return 0 ;
```

Figure 4: **This version shows a solution to the programming problem using multithreading.**

MULTI12.C

2 of 2

```
        case WM_DESTROY:
             params.bKill = TRUE ;
             return 0 ;
        }
    return DefWindowProc (hwnd, message, wParam, lParam) ;
    }

// Window 2: Display increasing sequence of prime numbers
// ------------------------------------------------------

void Thread2 (PPARAMS pparams)
    {
    char szBuffer [16] ;
    int  iNum = 1, iLine = 0, i, iSqrt ;
    HDC  hdc ;

    while (!pparams->bKill)
        {
        do
            {
            if (++iNum < 0)
                iNum = 0 ;

            iSqrt = (int) sqrt (iNum) ;

            for (i = 2 ; i <= iSqrt ; i++)
                if (iNum % i == 0)
                    break ;
            }
        while (i <= iSqrt) ;

        iLine = CheckBottom (pparams->hwnd, pparams->cyClient, iLine) ;

        wsprintf (szBuffer, "%d", iNum) ;

        hdc = GetDC (pparams->hwnd) ;
        TextOut (hdc, 0, iLine * cyChar, szBuffer, strlen (szBuffer)) ;
        ReleaseDC (pparams->hwnd, hdc) ;

        iLine++ ;
        }
    }

LONG APIENTRY WndProc2 (HWND hwnd, UINT message, DWORD wParam, LONG lParam)
    {
    static PARAMS params ;

    switch (message)
        {
        case WM_CREATE:
             params.hwnd = hwnd ;
             _beginthread (Thread2, 0, &params) ;
             return 0 ;

        case WM_SIZE:
             params.cyClient = HIWORD (lParam) ;
             return 0 ;

        case WM_DESTROY:
             params.bKill = TRUE ;
             return 0 ;
        }
    return DefWindowProc (hwnd, message, wParam, lParam) ;
    }

// Window 3: Display increasing sequence of Fibonacci numbers
// ----------------------------------------------------------

void Thread3 (PPARAMS pparams)
    {
    char szBuffer [16] ;
    int  iNum = 0, iNext = 1, iLine = 0, iTemp ;
    HDC  hdc ;

    while (!pparams->bKill)
        {
        if (iNum < 0)
            {
            iNum  = 0 ;
            iNext = 1 ;
            }

        iLine = CheckBottom (pparams->hwnd, pparams->cyClient, iLine) ;

        wsprintf (szBuffer, "%d", iNum) ;

        hdc = GetDC (pparams->hwnd) ;
        TextOut (hdc, 0, iLine * cyChar, szBuffer, strlen (szBuffer)) ;
        ReleaseDC (pparams->hwnd, hdc) ;

        iTemp  = iNum ;
        iNum   = iNext ;
        iNext += iTemp ;

        iLine++ ;
        }
    }

LONG APIENTRY WndProc3 (HWND hwnd, UINT message, DWORD wParam, LONG lParam)
    {
    static PARAMS params ;

    switch (message)
        {
        case WM_CREATE:
             params.hwnd = hwnd ;
             _beginthread (Thread3, 0, &params) ;
             return 0 ;

        case WM_SIZE:
             params.cyClient = HIWORD (lParam) ;
             return 0 ;

        case WM_DESTROY:
             params.bKill = TRUE ;
             return 0 ;
        }
    return DefWindowProc (hwnd, message, wParam, lParam) ;
    }

// Window 4: Display circles of random radii
// -----------------------------------------

void Thread4 (PPARAMS pparams)
    {
    HDC hdc ;
    int iDiameter ;

    while (!pparams->bKill)
        {
        InvalidateRect (pparams->hwnd, NULL, TRUE) ;
        UpdateWindow (pparams->hwnd) ;

        iDiameter = rand() % min (pparams->cxClient, pparams->cyClient) ;

        hdc = GetDC (pparams->hwnd) ;

        Ellipse (hdc, (pparams->cxClient - iDiameter) / 2,
                      (pparams->cyClient - iDiameter) / 2,
                      (pparams->cxClient + iDiameter) / 2,
                      (pparams->cyClient + iDiameter) / 2) ;

        ReleaseDC (pparams->hwnd, hdc) ;
        }
    }

LONG APIENTRY WndProc4 (HWND hwnd, UINT message, DWORD wParam, LONG lParam)
    {
    static PARAMS params ;

    switch (message)
        {
        case WM_CREATE:
             params.hwnd = hwnd ;
             _beginthread (Thread4, 0, &params) ;
             return 0 ;

        case WM_SIZE:
             params.cxClient = LOWORD (lParam) ;
             params.cyClient = HIWORD (lParam) ;
             return 0 ;

        case WM_DESTROY:
             params.bKill = TRUE ;
             return 0 ;
        }
    return DefWindowProc (hwnd, message, wParam, lParam) ;
    }

// Main window to create child windows
// -----------------------------------

LONG APIENTRY WndProcMain (HWND hwnd, UINT message, DWORD wParam, LONG lParam)
    {
    static char  * szChildClass  [] = { "Child1", "Child2",
                                        "Child3", "Child4" } ;
    static HWND    hwndChild [4] ;
    static WNDPROC lpfnChildProc [] = { WndProc1, WndProc2,
                                        WndProc3, WndProc4 } ;
    HINSTANCE      hInstance ;
    int            i ;
    short          cxClient, cyClient ;
    WNDCLASS       wndclass ;

    switch (message)
        {
        case WM_CREATE:
             hInstance = (HINSTANCE) GetWindowLong (hwnd, GWL_HINSTANCE) ;

             wndclass.style         = CS_HREDRAW | CS_VREDRAW ;
             wndclass.cbClsExtra    = 0 ;
             wndclass.cbWndExtra    = 0 ;
             wndclass.hInstance     = hInstance ;
             wndclass.hIcon         = NULL ;
             wndclass.hCursor       = LoadCursor (NULL, IDC_ARROW) ;
             wndclass.hbrBackground = GetStockObject (WHITE_BRUSH) ;
             wndclass.lpszMenuName  = NULL ;

             for (i = 0 ; i < 4 ; i++)
                 {
                 wndclass.lpfnWndProc   = lpfnChildProc [i] ;
                 wndclass.lpszClassName = szChildClass [i] ;

                 RegisterClass (&wndclass) ;

                 hwndChild [i] = CreateWindow (szChildClass [i], NULL,
                       WS_CHILDWINDOW | WS_BORDER | WS_VISIBLE,
                       0, 0, 0, 0, hwnd, (HMENU) i, hInstance, NULL) ;
                 }

             cyChar = HIWORD (GetDialogBaseUnits ()) ;
             return 0 ;

        case WM_SIZE:
             cxClient = LOWORD (lParam) ;
             cyClient = HIWORD (lParam) ;

             for (i = 0 ; i < 4 ; i++)
                 MoveWindow (hwndChild [i], (i % 2) * cxClient / 2,
                                            (i > 1) * cyClient / 2,
                             cxClient / 2, cyClient / 2, TRUE) ;
             return 0 ;

        case WM_CHAR:
             if (wParam == '\x1B')
                 DestroyWindow (hwnd) ;

             return 0 ;

        case WM_DESTROY:
             PostQuitMessage (0) ;
             return 0 ;
        }
    return DefWindowProc (hwnd, message, wParam, lParam) ;
    }
```

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and all output to the window stops. In MULTI2, the output continues.

ANY PROBLEMS? I originally thought that MULTI2 would be much more complex than it actually turned out to be, mostly because I didn't believe that Windows NT was as bulletproof as it proved to be. Let's take a look at some examples of multithreaded "flaws" in MULTI2.C, using WndProc1 and Thread1 as examples.

WndProc1 runs in the main thread of MULTI2, and Thread1 runs concurrently with it. The points at which Windows NT switches between these two threads are variable and unpredictable.

Suppose Thread1 is running and has just executed the code that checks if the bKill field of the PARAMS structure is TRUE. It's not, but then Windows NT switches control to the main thread, at which time the user terminates the program. WndProc1 receives a WM_DESTROY message and sets the bKill parameter to TRUE. Oops! Too late! Suddenly the operating system switches to Thread1, and that function attempts to obtain a device context handle to a nonexistent window.

It turns out this is not a problem. Windows NT is sufficiently bulletproof so that the graphics functions simply fail without causing any problems, and without displaying the dreaded UAE message.

Proper multithreaded programming techniques mandate putting the GetDC, TextOut, and ReleaseDC functions in a *critical section.* This involves calling the EnterCriticalSection function before GetDC, checking again if bKill is FALSE before calling the graphics function, and calling the LeaveCriticalSection function after ReleaseDC. During a critical section, the operating system does not switch control to other threads in the process. Unfortunately, the critical section functions were inadequately documented in the March beta release of Windows NT, which is the latest release that I had access to when I was writing this column in early June.

Another problem is that the main thread could receive a WM_ERASEBKGND or WM_PAINT message during the time that a secondary thread is drawing its output. Again, using a critical section would help prevent any problems that could result from two threads attempting to draw on the same window. But experimentation seems to show that Windows NT properly serializes access to the graphics drawing functions. That is, one thread can't draw on a window while another thread is doing so.

The Windows NT documentation warns about one area where graphics functions are not serialized, and that involves use of GDI objects such as pens, brushes, fonts, bitmaps, regions, and palettes. It is possible for one thread to destroy an object that another thread is using. The solution to this problem requires use of a critical section or, better yet, not sharing GDI objects between threads.

OH, AND BY THE WAY Bill Gates and QuickBASIC 2.0 won that programming contest on October 3, 1986. But he didn't have to deal with multithreaded programming techniques, which we'll continue to examine in the next issue. □

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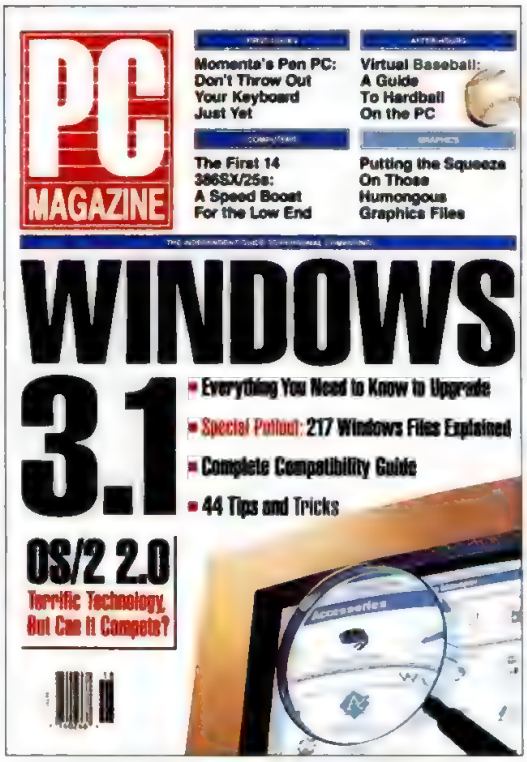

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Extending WinHelp with Custom DLLs

BY RAY DUNCAN

For some inexplicable reason, Microsoft has dubbed some capabilities of the Windows help system as *macros*. (See Power Programming, June 29, 1993.) For all practical purposes, macros are just function calls that can be triggered at the opening of a help file, the entry to a help file topic, or the user's selection of a hot spot. The help compiler and help viewer recognize a variety of *standard* macros, for which the code is presumably located in WINHELP.EXE itself, but it is also possible for a help file to invoke any other function that has been exported from a dynamic link library (DLL).

DLLs can be written in most mainstream programming languages and can be of arbitrary size and complexity. Moreover, DLLs can call any function in the Windows API, can call functions exported by other DLLs, and can even launch and communicate with other processes. Thus, the help system macro facility is really an extremely powerful back door that allows you to extend your help file and, by implication, the entire Windows help system, in any desired direction. It's even perfectly feasible to put the *engine* of an entire application in a DLL and just use a help file and the help viewer as the application's *front end*.

One of the fascinating aspects of custom macros and DLLs is their bringing us face to face with a WINHELP capability that most programmers don't even know exists. If a DLL that implements one or more help file macros has an exported function with the magic name LDLLHandler(), that function will be called by the help file viewer before any other function in the DLL, and LDLLHandler() can then request that WINHELP do some very interesting things on its behalf. Specifically, LDLLHandler() can indicate that it should be notified when certain help file events occur, and it can ask for a table of far pointers to help file access functions exported by WINHELP.

IMPLEMENTING LDLLHANDLER() You will not find a description of the LDLLHandler() function anywhere in the Microsoft Windows SDK manuals. This information is sequestered at the tail end of the unsupported Windows Help Authoring Guide, which can be found on the Microsoft Developer Network CD-ROM or in the Microsoft libraries on CompuServe. The constants and structures used by LDLLHandler() to communicate with WINHELP are defined in the header file DLL.H, which can be found in the same locations. The terminology used in connection with the LDLLHandler() function, as well as the various constants and function names declared in the file DLL.H, are quite unconventional by Windows SDK standards. It's almost as if the help subsystem was created by a rogue development group within Microsoft using Martian notation instead of Hungarian, or perhaps implemented first for Word and Excel for the Mac, then ported to Windows.

With the use of DLLs, the Windows help system macro facility becomes an extremely powerful way to extend your help files. A simple DLL provides a practical example.

In any event, the LDLLHandler() function is quite easy to implement and is basically nothing more or less than yet another type of callback procedure, much like a window callback, a dialog callback, or a system hook callback. For that matter, the calls to LDLLHandler() from WINHELP can be thought of as message-passing events, although you should not try to push the analogy with the more familiar Windows messages too far (for instance, LDLLHandler() messages are not queued). The prototype for LDLLHandler() is

```
LONG CALLBACK LDLLHandler(UINT
 wMsg, LONG lParam1, LONG lParam2)
```

The wMsg parameter defines the *message type*—the reason for the call to LDLLHandler(). The messages fall into six categories:

- The help viewer is querying which of the other possible messages LDLLHandler() wants to receive.
- The DLL containing LDLLHandler() is being loaded or unloaded.
- The help viewer's window is being resized, minimized, or maximized.
- The help viewer's window is gaining or losing the focus.
- The help viewer is moving from one topic to another, or from one help file to another.
- The help viewer is passing a far pointer to a table of function pointers.

The meaning of the lParam1 and lParam2 parameters (if any) depends on the value of wMsg. The components of the messages passed to LDLLHandler() are described in detail in Figure 1.

In order to see how LDLLHandler works, let's put it in context. Before a help file uses a custom macro, it must first declare that macro to WINHELP with

The Components of wMsg

wMsg	lParam1	lParam2	Description	LDLLHandler returns
DW_ACTIVATE	TRUE = focus gained, FALSE = focus lost	Not used	Help viewer's window is gaining or losing the input focus	TRUE to continue receiving this message, FALSE to disable further messages of this type
DW_CALLBACKS	Far pointer to a table of 16 far pointers for WinHelp exported functions	Not used	Help viewer is passing a far pointer to a function pointer table	TRUE to continue receiving this message, FALSE to disable further messages of this type
DW_CHGFILE	Far pointer to ASCIIZ pathname of new help file	Not used	Help viewer is changing files but has not yet displayed the destination topic	TRUE to continue receiving this message, FALSE to disable further messages of this type
DW_ENDJUMP	Byte offset of the new topic within the help file	Scroll bar position for the new topic	Help viewer has just entered a new topic and has updated the display	TRUE to continue receiving this message, FALSE to disable further messages of this type
DW_INIT	Not used	Not used	DLL containing LDLLHandler is being loaded	TRUE to continue loading of DLL, FALSE to force immediate unloading of DLL
DW_MINMAX	Minimized = 1, maximized = 2	Not used	Help viewer's window is being minimized or maximized	TRUE to continue receiving this message, FALSE to disable further messages of this type
DW_SIZE	High word = horizontal size, Low word = vertical size	Not used	Help viewer's window is being resized	TRUE to continue receiving this message, FALSE to disable further messages of this type
DW_STARTJUMP	Not used	Not used	Help viewer is about to move to a new topic	TRUE to continue receiving this message, FALSE to disable further messages of this type
DW_TERM	Not used	Not used	DLL containing LDLLHandler is being unloaded	Ignored
DW_WHATMSG	Not used	Not used	Help viewer is querying what other messages LDLLHandler intends to process	Bit flags indicating which other messages should be sent to LDLLHandler (See text.)

Figure 1: **The components of the messages passed to LDLLHandler() by WinHelp.**

the standard macro function RegisterRoutine(). The parameters for RegisterRoutine() are the filename for the DLL containing the executable code for the custom macro, the name of the macro, and a string which defines the parameters that are accepted by the macro. This is conceptually similar to prototyping a C function in a header file, so it can be referenced in other routines before it is actually defined, or referenced in other modules that #include the same header file.

Apparently, WINHELP doesn't do much in response to the RegisterRoutine() macro except store the parameters internally in a table. Only when the custom macro that was previously declared with RegisterRoutine() is actually executed does WINHELP go looking for the DLL and bring it into memory. (This can easily be demonstrated by putting a RegisterRoutine() statement with a bogus DLL name or macro name in the [CONFIG] section of an .HPJ file. WINHELP will load and display the resulting help file without complaint so long as the nonexistent custom macro is not executed.)

During the loading of the DLL containing the custom macro, WINHELP calls GetProcAddress() with the ASCIIZ string "LDLLHandler" to see if the DLL contains that function and has exported it. If GetProcAddress() returns an error, WINHELP proceeds on its way, calling GetProcAddress() to get the entry point of the macro being referenced, then loading the parameters specified in the help file onto the stack and calling the macro (exported DLL function) itself. However, if GetProcAddress() for the string "LDLLHandler" succeeds, WINHELP goes off on a little tangent.

WINHELP first calls LDLLHandler() with the wMsg value DW_WHATMSG. LDLLHandler() responds to DW_WHATMSG by returning an OR'd combination of bit flags that indicate which of the other WINHELP DW_*xxxx* messages it wishes to receive. The flags are defined as constants with names of the form DC_*xxxx*, and the messages they enable are as follows:

```
Flag name          Enables messages

DC_MINMAX          DW_MINMAX, DW_SIZE
DC_INITTERM        DW_INIT, DW_TERM
DC_JUMP            DW_STARTJUMP,
                   DW_ENDJUMP,
                   DW_CHGFILE
DC_ACTIVATE        DW_ACTIVATE
DC_CALLBACKS       DW_CALLBACKS
```

When LDLLHandler() returns from the DW_WHATMSG message, WINHELP checks the returned flags and, if neces-

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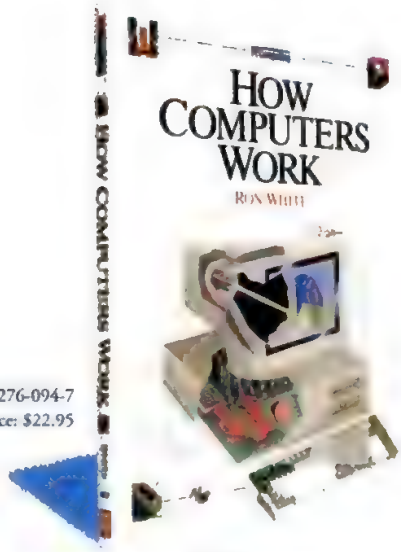

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sary, calls LDLLHandler() again with the DW_INIT and/or DW_CALLBACKS messages. It then goes on to call the DLL's macro function that was referenced in the help file.

For example, if a DLL containing a custom macro wanted to be notified when the help viewer's window was resized, maximized, minimized, or had gained or lost the focus, it would contain an LDLLHandler() routine that looked something like this:

```
LONG CALLBACK LDLLHandler(UINT
 wMsg, LONG lParam1, LONG lParam2)
{
    switch(wMsg)
    {
        case DW_WHATMSG:
            return(DC_MINMAX |
                   DC_ACTIVATE);
        .
        .
        .
    }
    return(FALSE);
}
```

Note that the existence of the DW_INIT message implies that, unlike other DLLs, a DLL containing a custom help macro and an exported LDLLHandler() procedure has two chances to perform initialization or to (optionally) fail the loading of the DLL. The first opportunity is during the processing of the LoadLibrary() function call from WINHELP, when the system loader calls the DLL's LibEntry routine. The second is when WINHELP calls the LDLLHandler() routine directly with the message DW_INIT, after it has already called LDLLHandler() with the message DW_WHATMSG and received a result that includes the flag DC_INITTERM.

CALLING WINHELP FUNCTIONS FROM A DLL There are many situations where the DLL code that implements a custom macro might need detailed information about the help viewer's position in the help file, or might even need to access the actual contents of the help file. This would not be a trivial chore in the absence of support from WINHELP, though, for several reasons:

- The format of a help file can change, and in fact has, changed from one version of Microsoft Windows to another.
- Help files can be compiled with various levels of compression, depending on the help file author's desire to trade speed for disk space.
- Help files are actually little file systems in their own rights and can contain many distinct named components known as *baggage files*, in addition to the text and graphics displayed by the help viewer.

Fortunately, WINHELP makes a whole battery of functions for help file access available for use by a DLL. These functions, which presumably are symmetrical with (or maybe the same as) the functions that WINHELP itself uses to access the help file, are summarized in Figure 2. The 18 functions fall into three categories:

- functions that obtain state information from WINHELP or that display error messages;
- functions that open and close help file systems (.HLP files); and
- functions that access baggage files within .HLP files.

As you can see from Figure 2, the naming of the functions is opaque and bi-

WinHelp Functions

Function	Description
ErrorSz()	Given a far pointer to an ASCIIZ error message, displays a standard WINHELP error dialog.
ErrorW()	Given an error message identifier from the set defined in DLL.H, displays a standard WINHELP error dialog.
FAccessHfs()	Return code indicating whether specified baggage file exists within the help file system. (The function accepts an "access mode" flag in addition to the baggage file name, but the mode portion is unimplemented.)
FAPI()	Issues a standard command to the help viewer. Basically equivalent to a WinHelp() API function call, but the command is sent directly to WINHELP instead of via the Windows kernel.
FEofHf()	Return flag indicating whether baggage file pointer is at the end of the file.
HfOpenHfs()	Opens a baggage file within a help file system. Returns a handle for the baggage file.
HfsOpenSz()	Opens a help file system, returning a handle.
LcbReadHf()	Reads bytes from a previously opened baggage file.
LcbSizeHf()	Returns size in bytes of specified baggage file.
LcbWriteHf()	Writes bytes to a previously opened baggage file.
LGetInfo()	Retrieves various useful information from WINHELP, including the application instance handle, the handle for the main viewer window, the current window handle, the handle for the current help file, foreground and background colors, the current topic number, and the handle to a memory block containing the current path.
LSeekHf()	Sets baggage file pointer position for subsequent read or write operation.
LTellHf()	Returns current baggage file pointer position.
RcCloseHf()	Closes a baggage file with a help file system.
RcCloseHfs()	Closes a help file system. Any baggage files that were opened within the help file system should be closed before calling this function.
RcGetFSError()	Returns the most recent error encountered during a help file system function call.
RcLLInfoFromHf()	Given a baggage file handle, returns size and offset information for the baggage file within a help file system.
RcLLInfoFromHfs()	Given a help file system handle and the ASCIIZ name of a baggage file, returns size and offset information for the baggage file within the help file system.

Figure 2: **The WinHelp functions for help file access that can be called from a DLL. The term *help file system* refers to a standard Windows help (HLP) file. The term *baggage file* refers to a file that has been embedded within an .HLP file and is only accessible via these functions; a baggage file is not visible at the DOS file system level, and handles used to access baggage files are not standard DOS file handles. More information about these functions can be found in the file DLL.H.**

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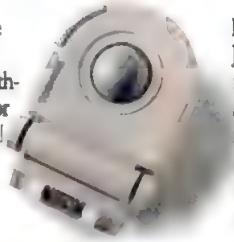

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DEMODLL.C


```
// DEMODLL.C - Demonstrate use of WINHELP internal functions
// and access to "baggage" files within a Windows HLP file.
// Copyright (C) 1993 Ray Duncan
// PC Magazine * Ziff Davis Publishing

#include <windows.h>
#include <commdlg.h>
#include "dll.h"
#include "demodll.h"

#define READSIZE 32768                      // size of I/O buffer
#define EXENAMESIZE 256                     // max size of pathname

// far pointers to WINHELP internal functions
LPFN_HFSOPENSZ      lpfnHfsOpenSz;          // open HLP file system
LPFN_RCCLOSEHFS     lpfnRcCloseHfs;         // close HLP file system
LPFN_FACCESSHFS     lpfnFAccessHfs;         // check baggage file
LPFN_HFOPENHFS      lpfnHfOpenHfs;          // open baggage file
LPFN_LCBREADHF      lpfnLcbReadHf;          // read baggage file
LPFN_RCCLOSEHF      lpfnRcCloseHf;          // close baggage file

//
// LibMain() -- initialization routine called by system loader (via
// LibEntry) when DLL is first loaded.  Called with the module handle
// for the DLL, the size of the local heap, and a pointer to the
// command line.  Returns TRUE if DLL initialization successful,
// FALSE if initialization failed.
//

INT CALLBACK LibMain(HANDLE hModule, WORD wDataSeg, WORD cbHeap, LPSTR lpchCmdLine)
{
    if (cbHeap)                             // unlock data segment
        UnlockData(0);                      // if DLL has its own
                                            // local heap
    return(TRUE);
}

//
// WEP - termination routine called by system just before the
// DLL is unloaded from memory.  The parameter idParam is not used.
// The routine always returns TRUE.
//
INT CALLBACK WEP(INT idParam)
{
    return(TRUE);
}

//
// LDLLHandler() -- Callback entry point from WINHELP.EXE. Called
// with DW_WHATMSG the first time a macro within the DLL is run from
// the HLP file. The routine will be called additional times with
// other messages depending on what flags were returned by this
// routine in response to the DW_WHATMSG message.
//
LONG CALLBACK LDLLHandler(WORD wMsg, LONG lParam1, LONG lParam2)
{
    switch(wMsg)
    {
        case DW_WHATMSG:                    // we only want the
            return(DC_CALLBACKS);           // DW_CALLBACKS message

        case DW_CALLBACKS:                  // save entry points
            GetCallBacks((VPTR) lParam1);
            return(TRUE);
    }

    return(FALSE);
}


//
// GetCallBacks -- called from LDLLHandler in response to the
// DW_CALLBACKS message. Extracts the addresses of the WINHELP
// entry points for the functions that will be used by
// CopyBaggage from the far pointer array whose address was
// passed to LDLLHandler, and saves the addresses in
// global variables.
//
VOID GetCallBacks(VPTR VPtr)
{
    lpfnHfsOpenSz       = (LPFN_HFSOPENSZ) VPtr[HE_HfsOpenSz];
    lpfnRcCloseHfs      = (LPFN_RCCLOSEHFS) VPtr[HE_RcCloseHfs];
    lpfnFAccessHfs      = (LPFN_FACCESSHFS) VPtr[HE_FAccessHfs];
    lpfnHfOpenHfs       = (LPFN_HFOPENHFS) VPtr[HE_HfOpenHfs];
    lpfnLcbReadHf       = (LPFN_LCBREADHF) VPtr[HE_LcbReadHf];
    lpfnRcCloseHf       = (LPFN_RCCLOSEHF) VPtr[HE_RcCloseHf];

    return;
}

//
// CopyBaggage() -- called as a "macro" from within a HLP file
// to copy a baggage file from the HLP file's internal file system
// to an ordinary DOS file.  Arguments are the name of the HLP
// file, the name of the baggage file, the default name for the
// DOS file, the address of the Help error structure, and two
// flags that control display of the SaveAs and advisory dialogs.
// Returns TRUE if the copy was successful, FALSE otherwise.
//
BOOL CALLBACK CopyBaggage(LPSTR szHelpFile, LPSTR szSourceFile,
  LPSTR szDefaultDest, QME lpHelpError, UINT fSaveAs, UINT fAlert)
{
    BOOL    fStatus;                        // operation status
    HANDLE  hHelpFile = 0;                  // HLP file handle
    HANDLE  hSourceFile = 0;                // baggage file handle
    HFILE   hDestFile = -1;                 // output file handle
    UINT    ReadLen, WriteLen;              // bytes read, written
    HGLOBAL hBuffer = 0;                    // I/O buffer handle
    LPBYTE  lpBuffer;                       // I/O buffer pointer
    OPENFILENAME ofn;                       // used by common dialog
    OFSTRUCT ofs;                           // used by OpenFile
    CHAR    szDestFile[EXENAMESIZE];        // destination filename
    CHAR    szTemp[256];                    // scratch buffer

    // set default error result and error action
    lpHelpError->wError == wMERR_NONE;
    lpHelpError->fwFlags = fwMERR_ABORT;

    // retrieve default destination filename
    lstrcpy(szDestFile, szDefaultDest);

    // try and open HLP file, exit if unsuccessful
    hHelpFile = (*lpfnHfsOpenSz)(szHelpFile, fFSOpenReadOnly);
    if(!hHelpFile)
        goto CopyError;

    // check if source file exists within HLP file system
    fStatus = (*lpfnFAccessHfs)(hHelpFile, szSourceFile, NULL);
    if(!fStatus)
        goto CopyError;

    // try and open the source file for I/O
    hSourceFile = (*lpfnHfOpenHfs)(hHelpFile, szSourceFile, fFSOpenReadOnly);
    if(!hSourceFile)
        goto CopyError;

    if(fSaveAs)                             // use Save-As dialog?
    {
        // initialize the data structure used by the common Save-As
        // dialog, then prompt the user for the destination filename,
        // using the filename passed as szDefaultDest as the default
        ofn.lStructSize = sizeof(OPENFILENAME); // length of structure
        ofn.hwndOwner = NULL;               // handle of owner window
        ofn.lpstrFilter = NULL;             // address of filter list
        ofn.lpstrCustomFilter = NULL;       // custom filter address
        ofn.nFilterIndex = 1L;              // ignored for now
        ofn.lpstrFile = szDestFile;         // buffer for pathname
        ofn.nMaxFile = EXENAMESIZE;         // size of buffer
        ofn.lpstrFileTitle = NULL;          // buffer for filename only
        ofn.lpstrInitialDir = NULL;         // initial directory
        ofn.lpstrTitle = NULL;              // title for dialog box
        ofn.Flags = OFN_PATHMUSTEXIST |     // various dialog flags
                    OFN_HIDEREADONLY | OFN_NOTESTFILECREATE;
        ofn.lpstrDefExt = NULL;             // default extension

        if(!GetSaveFileName(&ofn))          // display save-as dialog
            goto CopyError;                 // exit if user canceled
    }

    // allocate memory for use as an I/O buffer
    hBuffer = GlobalAlloc(GMEM_MOVEABLE, READSIZE);
    if(!hBuffer)
        goto CopyError;

    // get far pointer to the I/O buffer
    lpBuffer = GlobalLock(hBuffer);

    // create the destination file
    hDestFile = _lcreat(szDestFile, 0);
    if(hDestFile == HFILE_ERROR)
        goto CopyError;

    // copy the data from the HLP file system to the
    // newly created destination file
    do {

        ReadLen = (*lpfnLcbReadHf)(hSourceFile, lpBuffer, READSIZE);
        WriteLen = _lwrite(hDestFile, lpBuffer, ReadLen);

        if(ReadLen != WriteLen)
```

Figure 3: **DEMODLL.C is the source file for DEMODLL.DLL. This dynamic link library contains a routine called CopyBaggage, which can be invoked as a help file macro to copy a baggage file from a help file to a separate disk file.**

DEMODLL.C

2 of 2

```
        goto CopyError;

 } while(ReadLen == READSIZE);

// close all files, release I/O buffer
(*lpfnRcCloseHf)(hSourceFile);
(*lpfnRcCloseHfs)(hHelpFile);
_lclose(hDestFile);
GlobalUnlock(hBuffer);
GlobalFree(hBuffer);

if(fAlert)                                  // display alert?
{
    // notify user of the successful file transfer
    wsprintf(szTemp, "Baggage file %s\nfrom help file %s\n"
                     "was copied to %s.",
             (LPSTR) szSourceFile, (LPSTR) szHelpFile,
             (LPSTR) szDestFile);
    strlwr(szTemp);
    MessageBox(NULL, szTemp, "DEMODLL", MB_OK);
}

// return success flag to WINHELP.EXE
return(wMERR_NONE);

CopyError:                                  // common error exit

    // close any files that were opened, kill
    // partial output file if necessary
    if(hHelpFile)
        (*lpfnRcCloseHfs)(hHelpFile);
    if(hSourceFile)
        (*lpfnRcCloseHf)(hSourceFile);
    if(hDestFile != -1)
    {
        _lclose(hDestFile);
        OpenFile(szDestFile, &ofs, OF_DELETE);
    }

    // release I/O buffer if it was allocated
    if(hBuffer)
    {
        GlobalUnlock(hBuffer);
        GlobalFree(hBuffer);
    }
                                            // display alert?
    if(fAlert)
    {
        // notify user of the unsuccessful operation
        wsprintf(szTemp, "Baggage file %s\nfrom help file %s\n"
                         "could not be copied.",
                 (LPSTR) szSourceFile, (LPSTR) szHelpFile);
        strlwr(szTemp);
        MessageBox(NULL, szTemp, "DEMODLL", MB_OK);
    }

    // set error code, return error flag to WINHELP.EXE
    lpHelpError->wError = wMERR_ERROR;
    return(wMERR_ERROR);
}
```

zarre even by Microsoft standards. The documentation for the functions is limited to what you can deduce and conjecture from the DLL.H header file and the DLLDEMO example on the Microsoft Developer Network CD-ROM. It's surprising that Microsoft doesn't rationalize this interface and do a better job of making it visible to developers, considering that the interface has been stable for at least three years and is used extensively in Microsoft's own products. Two particularly interesting features of the interface are that a DLL can access help files other than the one currently being displayed to the WINHELP user, and that baggage files can be written as well as read (although apparently they can't be created on the fly).

A custom macro gets its hands on the 18 functions published by WINHELP in a roundabout manner. First the DLL must include an LDLLHandler() function. When WINHELP calls that function with the DW_WHATMSG message, the function must return (among other flags) the flag DC_CALLBACKS. WINHELP will then immediately call LDLLHandler() again, passing as parameter lParam1 a far pointer to an array of far pointers, one for each of the WINHELP functions that can be called by the DLL. LDLLHandler() then dereferences lParam1 to copy the far pointers for the WINHELP functions that it plans to use from the far array to static function pointers in its own data segment, using array indices defined in DLL.H with names of the form HE_*xxxx*. The WINHELP routines can then be called via the static function pointers by the other procedures in the DLL when the latter are activated by the execution of a help file macro.

Why would you want to bother with this whole messy business? Well, the capability of bundling files into an application's help file as *baggage* is attractive for several reasons. It reduces the number of files you must distribute, it eliminates clutter on the user's hard disk, and the user need not even be aware of the existence of the baggage files until he or she actually has a need for them. For example, if you distribute a shareware Windows program, you will undoubtedly provide complete documentation on-line in the help file, but you might also want to give the user the option of generating a paper manual. You can simply print the manual to a disk file, embed that file into the help file as baggage, and add a menu item or hot spot to the help file that the user can select to extract the baggage back out of the help file into a separate disk file. Of course, this means that you must ship a DLL containing a custom macro that does the baggage extraction, and I'll show you exactly such a DLL in a moment.

What if you wanted to call the functions exposed by WINHELP directly from an application? As far as I can see, there is no direct route to this goal because you can't get the addresses of the functions without an LDLLHandler() routine in a DLL, and the LDLLHandler() routine won't get called unless the DLL is loaded by WINHELP. So you are stuck with a scenario something like the following:

1. A DLL is prepared that contains at least one exported routine that will be executed as a help file macro, one or more other exported routines that will be called from the application, and an exported LDLLHandler() function.

2. The application calls the WinHelp() API with the name of some help file and the command HELP_CONTENTS, forcing the launch of WINHELP.EXE.

3. The application calls WinHelp() with the command HELP_COMMAND twice—once to run the RegisterRoutine() macro and once to run the custom macro in the DLL. At this point, the DLL can be assumed to have initialized itself and obtained the pointers to the functions in WINHELP.EXE.

4. The application calls LoadLibrary() to get a module handler for the DLL, calls GetProcAddress() for one or more of the

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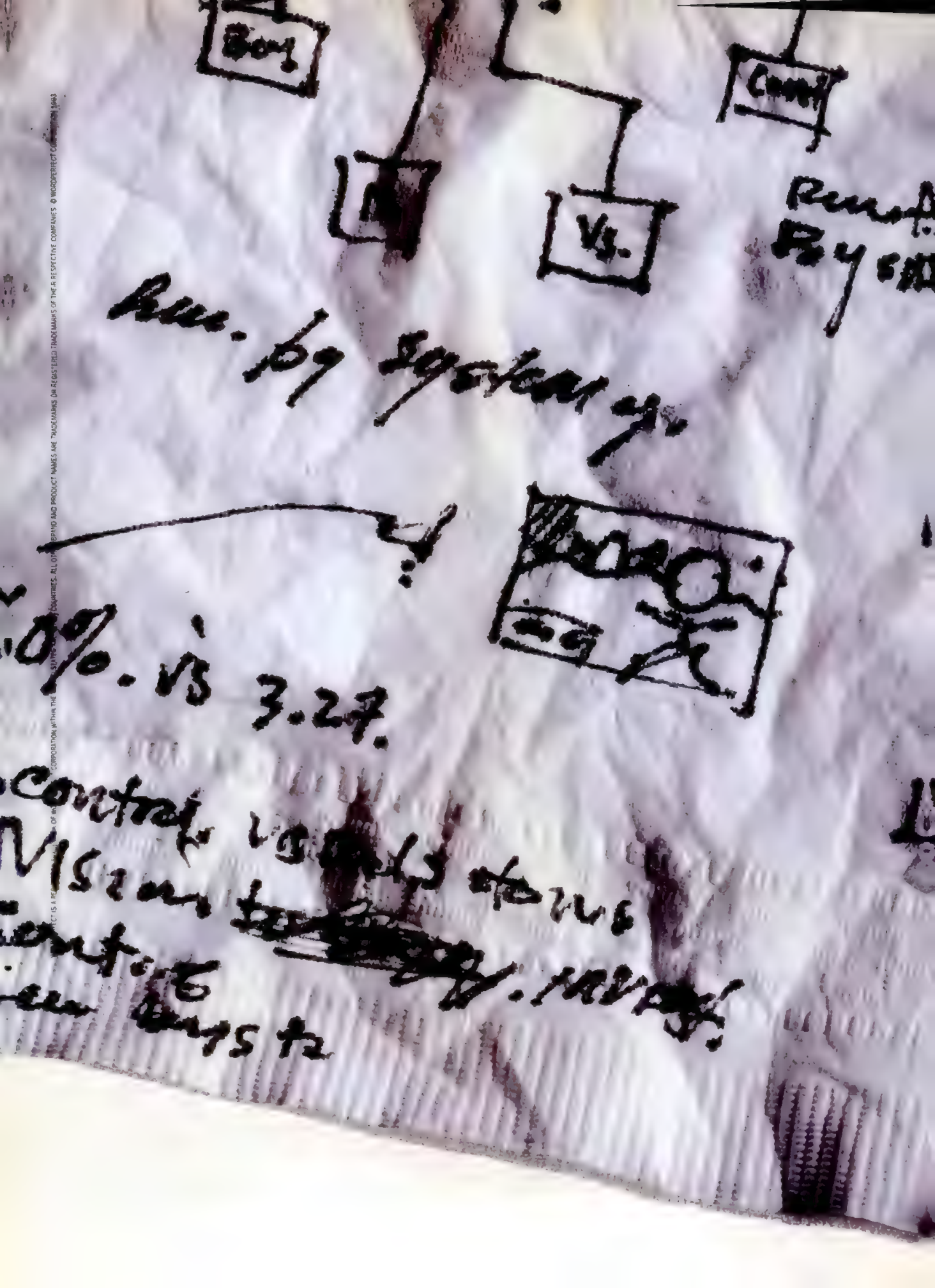

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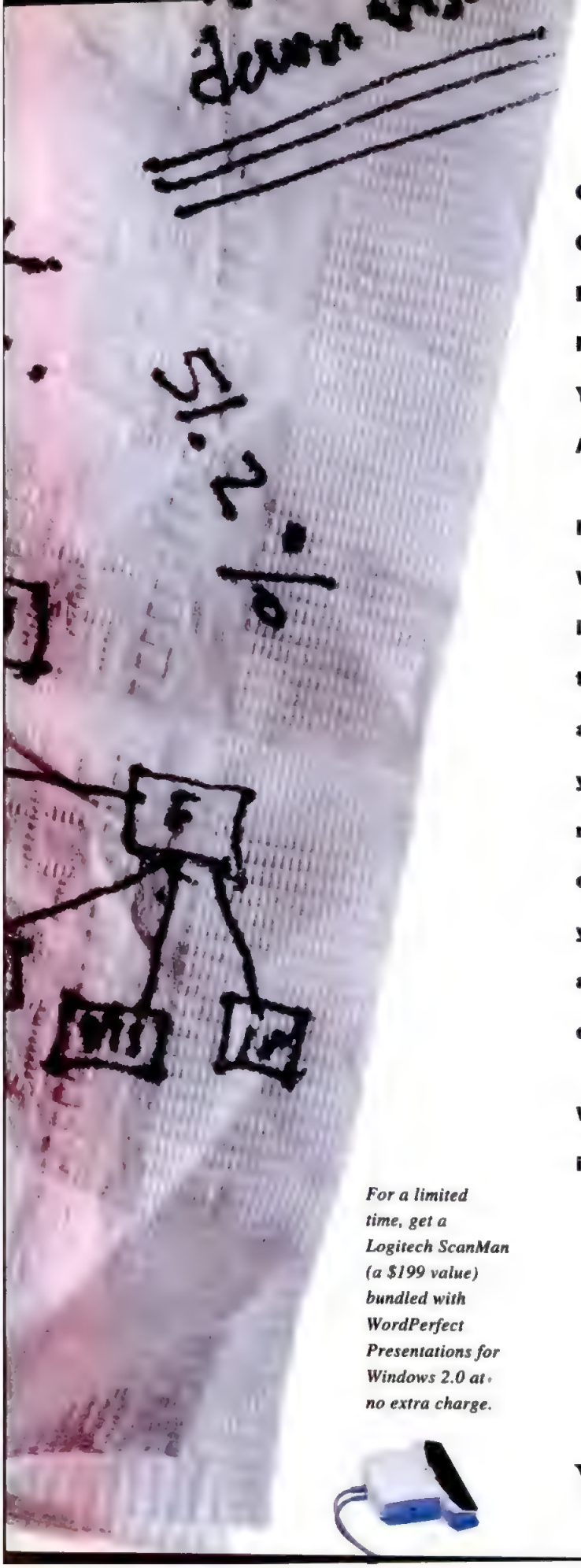

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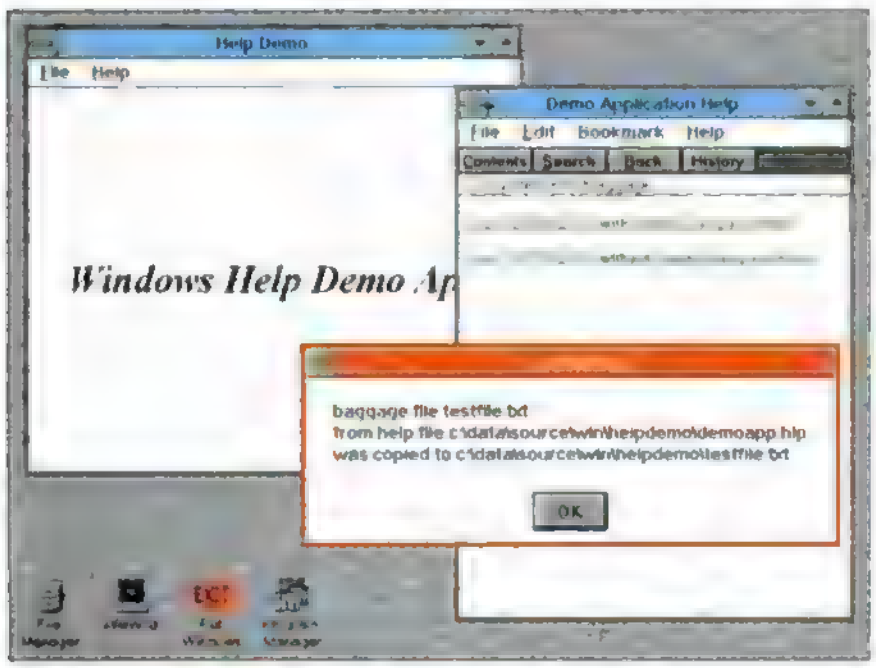

Figure 4: The CopyBaggage macro in action, as well as DEMOAPP.EXE and DEMOAPP.HLP.

DLL's exported functions, then relies on those functions to call WINHELP and carry out the help file access on its behalf. Alternatively, the DLL could simply pass the array of WINHELP function pointers back to the application so that the application can call WINHELP without passing through the DLL.

There are many potential problems with this scenario, not the least of which are the facts that WINHELP is running as an independent process visible to the user and that it can be shut down unilaterally by the user at any time. The application is not notified of WINHELP's termination, so it will be nailed by a General Protection (GP) Fault the next time it tries to call a WINHELP function.

THE DEMODLL.DLL PROGRAM As a practical example of custom macros and DLL-WINHELP linkages, I have written a simple dynamic link library called DEMODLL.DLL that is designed to be used with the DEMOAPP.EXE application and the DEMOAPP.HLP help file that were discussed in the previous installment of this column. DEMOAPP .RTF, DEMOAPP.HPJ, and DEMOAPP.HLP were modified so that they include some dummy baggage files for you to experiment with. DEMODLL.DLL is partly modeled on the DLLDEMO sample program from Microsoft, but it is more flexible, more focused, and, I hope, considerably easier to understand.

The crucial feature of DEMODLL .DLL is the routine CopyBaggage(), which is designed to be called as a help file macro. CopyBaggage() will extract a baggage file from a help file and write it onto the disk as a separate file. The destination filename can be specified unequivocally in the macro call, or it can be entered by the user in a Save As... dialog with the default name specified in the macro call. CopyBaggage() returns a status value that can be tested in the help file, and it can also display optional "alert" dialogs that indicate the success or failure of the operation to the user.

Before it is used, CopyBaggage() must be declared in the help file with the execution of the following RegisterRoutine() macro:

```
!RegisterRoutine("demodll.dll",
 "CopyBaggage", "SSSSuu")
```

meaning that the CopyBaggage() macro can be found in the dynamic link library DEMODLL.DLL and that it accepts six parameters—four far pointers and two unsigned 16-bit integers. The most convenient way to declare CopyBaggage() is to place the RegisterRoutine() macro in the [CONFIG] section of the .HPJ file that is used to compile the help file. That way, the RegisterRoutine() macro will be run automatically each time the help file that uses CopyBaggage() is opened.

The C language prototype for CopyBaggage() looks like this:

```
BOOL CALLBACK CopyBaggage(LPSTR
 szHelpFile, LPSTR szSourceFile,
 LPSTR szDefaultDest,
  QME lpHelpError,
 UINT fSaveAs, UINT fAlert)
```

where the parameters for CopyBaggage() have the following meanings.

- szHelpFile: Far pointer to the pathname for the help file containing the baggage file of interest.
- szSourceFile: Far pointer to the ASCIIZ name of the baggage file within the help file.
- szDefaultDest: Far pointer to the ASCIIZ name to be assigned to the baggage file when it is written into a separate file on-disk.
- lpHelpError: Far pointer to a WINHELP structure that will be updated with status information by the CopyBaggage() routine.
- fSaveAs: Fflag that is TRUE if CopyBaggage() should display the Save As... dialog to the user with szDefaultDest as the default filename, FALSE if CopyBaggage() should use szDefaultDest and not display the SaveAs... dialog.
- fAlert: Flag that is TRUE If CopyBaggage() should display an "alert" dialog to the user indicating the success or failure of the operation, FALSE if CopyBaggage() should not display an alert dialog.

A typical invocation of CopyBaggage from a hot spot in a help file might look like this:

```
!CopyBaggage(qchPath,
 "testfile.txt", "testfile.txt",
 qError, 1, 1)
```

The "magic" names qchPath and qError are recognized by WINHELP and are replaced by far pointers to the pathname of the current help file and the WINHELP internal error data structure, respectively. In this particular example, the CopyBaggage() routine is being asked to find the baggage file *testfile.txt* within the currently open help file, present a Save As... dialog to the user with the default filename *testfile.txt*, copy the baggage file into a new disk file with the name specified by the user, and finally display an alert dialog summarizing the results of the operation.

The source code for DEMODLL .DLL is shown in Figure 3, and the CopyBaggage() alert dialog (along with DEMOAPP.EXE and DEMOAPP .HLP) are shown in Figure 4. The complete set of files that are necessary to rebuild and use DEMODLL.DLL—the source files for DEMODLL.DLL, DEMOAPP.HLP, and DEMOAPP .EXE, along with the compiled versions of all three of these files—can be downloaded from the Programming Forum on PC MagNet, archived as DEMODLL .ZIP.

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Peripherals

VIDEO CARDS FOR OS/2

❓ Is there an *ideal* type of video card to use with OS/2? It seems as though an accelerator chip that speeds up Windows would also work for OS/2. Is this true?

Dean Perry
San Diego, California

▶**PC MAGAZINE:** In theory, you're right—an accelerated video chip can help improve OS/2 performance. Unfortunately there's no direct correlation between Windows and OS/2 video performance.

The main reason for this is the drivers. In order for a program (or operating system) to work with a given piece of hardware, it needs to know how to communicate with that hardware. OS/2 cannot use BIOS calls to set video modes on the cards, so drivers have to be coded specifically for individual hardware designs. One problem with OS/2 2.0 is that because of a delay in getting developers the information they needed to create video drivers, manufacturers were slow to provide drivers for their cards.

IBM tackled this problem, in part, by developing drivers of its own. OS/2 2.0 users were able to get a set of supplemental drivers, but now these drivers are included in Version 2.1. As a result, Version 2.0 users will have to upgrade to 2.1 to get the new drivers.

You still need to pick the best card, however, and that's not easy to do. Given the difficulty with obtaining drivers, it's been hard to test new boards for their OS/2 performance. And since OS/2 users still represent a small minority of readers of *PC Magazine* and most other computer magazines, there hasn't been a great demand to add OS/2 performance testing to video board evaluations. Your best bet is to check with the manufacturer before you make your choice and ask whether or not it supplies OS/2 drivers for its boards, and which accelerator functions are implemented in those drivers.—*Alfred Poor*

UPGRADING AN NEC CD-ROM DRIVE

❓ I recently upgraded my NEC CDR-83 to the CDR-84 level through NEC's "M" Enhancement Program, but I'm having a hard time perceiving any difference in performance. How can I tell if I'm getting any extra speed? I can't use benchmark tests, since they need to write files to the disk. Is there any way to test a CD-ROM drive?

Daniel Zelenak
Rochester, Michigan

▶**PC MAGAZINE:** It's not widely known, but Trantor Systems performs an upgrade on NEC CDR-73 and CDR-83 drives to give them the same double-speed performance as the newer -74 and -84 models. The mechanical components remain unchanged; the conversion requires new firmware and some changes in the logic. Once this is completed, the drive can transfer data as fast as 300 KBps (kilobytes per second) by spinning the CD-ROM disk at twice the normal speed. (Normal speed is the 150 KBps rate used by CD audio disks; the drive will slow down to that rate when playing audio tracks.) So if you have one of these older drives and want to improve system performance, you may want to consider upgrading your drive.

Adding double-speed capabilities to your CD-ROM drive will result in faster data transfers, but since there are other factors that influence performance, you're not likely to see the effects on anything but files of 1MB or larger (such as true-color bitmap images or animation files).

Keep in mind, however, that this increased performance isn't always notice-

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See index, page 385.

able. For example, let's say you have the Computer Select CD-ROM and you want to view the features table in the LAN e-mail story that appeared in our October 27, 1992 issue. The information is stored in a worksheet that is just over 11K in size. A single-speed CD-ROM drive can transfer this in about 0.07 seconds. While a double-speed CD-ROM drive can perform the transfer in half that time, you're not likely to notice the 30- or 40-millisecond difference. For files of this size, you'd be far more likely to notice differences in the average seek times of the drives. Most drives are rated between 280 and 450 ms average seek time, which can result in a performance difference of 0.1 to 0.2 seconds.

For large files, however, double-speed does make a difference. Autodesk Animator flick files have become a widely accepted standard for animation files, and it's not uncommon for them to be over 1MB. A single-speed drive will read a megabyte of data in about 6.7 seconds, while a double-speed drive can do it in about 3.3 seconds. The benefit of this is not just the time saved; viewing an animation with the slower drive can result in a jerky playback because the computer must pause the display while it waits for more data from the CD.

If you want to test the speed of a CD-ROM drive, you need to start with a relatively large file on a CD. The CorelDRAW CD-ROM comes with a sizeable collection of Animator flick files, many of which are large enough to give your drive a good workout. (You can view flick files using the Windows 3.1 Media Player applet with an animation driver that you can download for free from the Autodesk Software Forum on CompuServe: NEWPLA.ZIP in the Autodesk Animator Library number 2. The .ZIP file also includes Animation Player, a Windows application released into public domain by Autodesk.)

If you don't have the CorelDRAW CD-ROM, check your CDs for any files that are 1MB or larger. You can then time how long it takes to load the file into an application (for instance, loading a large 24-bit color image into a paint program). You can also time how long it takes to copy the file to NUL. These techniques should demonstrate the extra transfer speed that the new breed of double-speed CD-ROM drives are capable of delivering.—*Alfred Poor*

Our Advisors

Douglas Boling is a contributing editor and the author of many utilities, including MBOOT.COM and EMS40.SYS.

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Operating Environments

SHELLING TO DOS

❓ I'm interested in controlling what happens when a DOS program (WordPerfect, for instance) "shells" to DOS. Specifically, I'd like to have a batch file execute automatically when the user shells to DOS. An EXIT command at the end of the batch file would return the user to the application.

I've considered using DOS commands, modifying the particular program's code, or patching DOS's COMMAND.COM, but my attempts thus far have been unsuccessful.

Bruce K. Karberg
Cleveland, Ohio

▶**PC MAGAZINE:** Here's a technique that will work with many applications—I'll demonstrate with WordPerfect. Create the batch file (say, DOS.BAT) that you want to run when a user shells out of WordPerfect, making sure its last line is the EXIT command. Put it in a directory on your PATH. Now create a data file

called RUNDOS.DAT, with many identical lines: the name of the batch file (minus its .BAT extension). How many lines? Since any nonempty file takes at least one cluster of disk space (usually 2K), use the largest number of lines that will fit in 2,048 bytes. If the batch file has a 3-letter name, you can fit over 400 lines in the data file.

Start WordPerfect with the command `WP < RUNDOS.DAT`, including any command line parameters you normally use. This command redirects the contents of RUNDOS.DAT into WordPerfect's standard input. However, like almost all major applications, WordPerfect doesn't use standard input, so the redirection has no effect on the ordinary operation of the program.

The DOS command line, however, does get its input from standard input, so when the user shells out to DOS the contents of the data file become *commands*. Each line calls the DOS.BAT batch file, and the EXIT command at the end of the batch file ends the DOS shell. Each time the user shells out, the next line of the data file again calls the special batch file.

Note that you can also *prevent* the user from shelling to DOS. Simply fill the data file with as many EXIT command lines as will fit in 2K. Any time the user attempts to shell to DOS, the EXIT command will end the DOS shell instantly!

There are some potential difficulties with this technique. If you've supplied a data file with 400 lines and the user shells out 401 times, the system will lock up. And you will have to experiment to see if the technique works with other specific applications. Still, this is a better solution than attempting to patch COMMAND .COM or applications.

— *Neil J. Rubenking*

CONTROLLING THE WIN 3.1 CONTROL PANEL

TIP Suppose you want to simplify the appearance of Control Panel or prevent a user from gaining control over certain Windows functions in the Control Panel. Or maybe there are some Control Panel functions you set up once and will never touch again. Why look at them every day if you're not going to use them?

Use NOTEPAD or any plain text editor to add a `[Don't load]` section to CONTROL.INI (like most .INI files, located in your Windows directory). To prevent the display of a particular Control Panel applet, put a line in that section containing the applet's exact title, like this:

```
[Don't load]
MIDI Mapper=true
```

All of the applets can be "hidden" in this fashion. To restore the applet to the Control Panel display, delete the appropriate line from CONTROL.INI and restart Control Panel.

Todd Henschell
Burbank, California

▶PC MAGAZINE: How often do you use applets like Keyboard, Sound, and International once you've set their initial values? This tip lets you weed out the rarely

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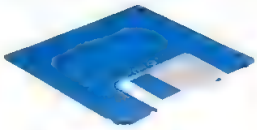

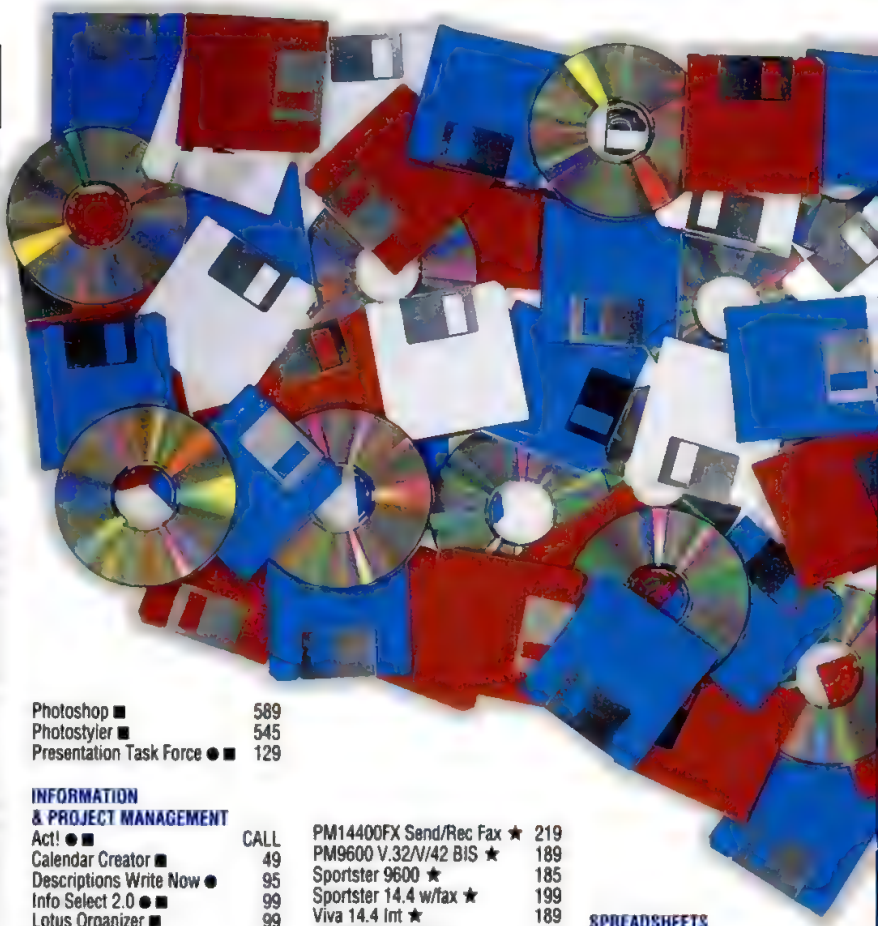

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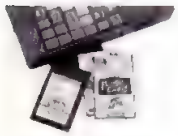

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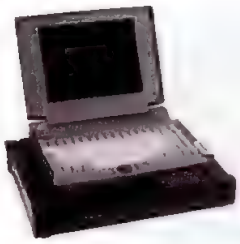

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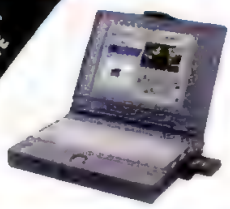

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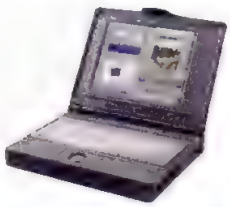

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used applets, making the ones you do use easier to find. Note that unlike many .INI file changes, this one doesn't require you to restart Windows. Just restart Control Panel and your changes take effect.

In Windows 3.0, the list of Control Panel applets was hard-coded into CONTROL.EXE and the size of the Control Panel window was fixed. In version 3.1, however, Control Panel loads its list of applets at runtime. The file MAIN.CPL contains most of the standard applets, but Control Panel will also load applets from any other valid .CPL file in the System directory. Control Panel adjusts its window size to accommodate the number of applets actually loaded. It's this "open architecture" that makes it possible to suppress loading certain applets. Control Panel consults the `[Don't load]` section of CONTROL.INI during initialization and skips any applets named there. Even the Windows Resource Kit doesn't mention this, but the information is available in the Microsoft Knowledge Base (GO MSKB) on CompuServe. The MSKB article indicates that a key value of 0 or 1 will suppress loading of the program; my own observation suggests that *any* nonempty value will do the job.
—*Neil J. Rubenking*

Word Processing

LOADING ASCII FILES INTO WORDPERFECT

❓ I have problems maintaining formats when loading ASCII text files into WordPerfect 5.1. The typical file I import consists largely of paragraphs of continuous text, in lines of 80 characters each. In addition, there are some columns that look much like a memo heading, taking the following form:

```
To   : Name
       Street Address
       City, State
From : Name
       Street Address
       City, State
```

The To and From begin at the first character of the line. The rest of the text is indented seven characters.

I find two problems whenever I load such files into WordPerfect using the standard retrieve function. First, there is a hard carriage return (`[HRt]`) at the end of every line, rather than at the end of each paragraph. Second, the indented columns are slightly misaligned—enough to be noticeable when printing with the Dutch Roman 10-point font I've set as the default. I can fix the alignment and delete the hard returns manually, of course. But I work with imported files frequently, and I wonder if there is any way to avoid the problem.

John Cosgrave
Markham, Ontario, Canada

▶PC MAGAZINE: If you have control over the source for the documents, you may be able to eliminate reformatting entirely. Otherwise you can use a macro to automate this tedious chore. Either way, it helps to understand what causes the problems you describe—both of which stem from what's in the ASCII file in the first place.

WordPerfect does not add the hard carriage returns; it simply lets you see them if you type Alt-F3 for Reveal Codes. Look for an option in the source program for creating the files without hard returns. Word 5.0, for example, can save a file as either Text-only, or as Text-only-with-line breaks, which adds a hard return after each line.

If you can't eliminate hard returns at the source, you may be able to strip them when you import the file into WordPerfect. Instead of using the retrieve command—with Shift-F10 or F5—try using Ctrl-F5 for Text In/Out, then choose DOS Text | Retrieve (CR/LF to [SRt] in HZone). This works best with a block format—where you have paragraphs containing no carriage returns separated by blank lines that consist of a hard carriage return alone. For formats that only separate a paragraph by ending it with one hard return and beginning the next with an indent, the hard return that ends paragraphs often disappears when you use this method.

The loss of column alignment comes from defining column placement with space characters and then using a proportionally spaced font. Quite simply, the second column is indented by seven *characters* on each line. But with proportional spacing, the width of characters varies, so the indentation varies as well.

Here again, you may be able to eliminate the problem right at the source, if you can use tabs rather than spaces to define the beginning position for the indented column. (Unfortunately, some applications won't let you use tabs for this purpose.) Notice that in the sample format, you need to treat the colons as being in their own columns, because of the space between the end of the word and the colon. After importing the file into WordPerfect, you can adjust the tab placement as needed.

If using tabs isn't possible, consider printing the files with a monospace font such as Courier. This will automatically align the columns, because each character is the same width. And that means an indent of any given number of characters will always translate to the same size indent.

If all else fails, you can record one or more macros for reformatting. The details will depend on what the files look like, but the trick is to use the search-and-replace command. Because the concept works for virtually any word processor, I'll outline the logic you should follow, rather than give keystroke-by-keystroke instructions.

For example, to reformat the first line in the memo format as shown, you would search for the word *To* followed by three spaces, a colon, and a space and replace it with *To* followed by a tab, a colon, and a tab.

To get rid of unwanted hard carriage returns, you should first provide markers for the hard returns you want to keep. If each paragraph starts with five spaces, you would search for a hard return followed by five spaces and replace it with @ (or another symbol you know isn't otherwise in the file) followed by a tab. You can then search for hard carriage returns and replace them with nothing, then finally add back the hard returns you need by searching for @ and replacing with hard returns. If you record this entire procedure as a macro, you can then run it in any similar file to get the formatted result.—*M. David Stone*

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SPEED UP EQUATION EDITOR IN WINWORD 2.X

TIP The Equation Editor that comes with Word for Windows 2.0 is useful for inserting complex formulas. However, repeatedly loading and exiting Equation Editor can get tiresome, since loading the program can take several seconds. Fortunately there's an easy way to speed up the process.

Start with the cursor positioned anywhere in the document where you do *not* want an equation, and load Equation Editor (by choosing Insert | Object | Equation). Then minimize the window (by clicking on the Minimize button or by opening the Control menu and choosing Minimize).

You can now insert equations wherever you want them by calling up Equation Editor as needed and closing each Equation Editor window as you finish with it. Because one instance of Equation Editor is already loaded in memory, you'll find that the loading time is reduced drastically. The only other difference is that every time you save your file, WinWord will ask if you want to update it first. It doesn't matter what you answer, since the question refers to the minimized window that doesn't actually include an equation.

Giacomo Bonanno
Davis, California

▶PC MAGAZINE: On my 486/25, this trick cuts the time for opening an Equation Editor window down from about 5 seconds to well under 1 second. That's enough to matter on a document that's full of equations. As you might suppose, you can get the same effect by simply minimizing rather than closing the first equation you work with in a given session. However, leaving the minimized window empty leaves less room for confusion if you switch among windows.

Note that for even greater convenience you can combine this approach with a macro for opening Equation Editor, as described in the June 16, 1992, Working Word column. Attach the macro to a toolbar button or shortcut key, and you can open Equation Editor with a single click or keystroke.—*M. David Stone*

Spreadsheets

TWO TIPS ON UNDOCUMENTED 1-2-3 WYSIWYG FEATURES

TIP The Impress add-in for Lotus 1-2-3, Version 2.*x*, and the WYSIWYG add-in for 1-2-3, Versions 2.3 and 2.4, give users the ability to apply formatting attributes to portions of labels without formatting the entire label. You turn on an attribute—such as color or boldface—by typing Ctrl-A followed by the appropriate attribute code. And you turn the attribute off by typing Ctrl-N. You can also type Ctrl-E followed by a format code to turn off a specific attribute without turning off all the attributes currently in effect.

The Release 2.4 manual (page 60) lists 28 such formatting codes, plus 255 additional codes that provide font outlining in various sizes. I have discovered many more undocumented codes. Twelve of these accomplish the same tasks as codes listed in the manual, but many others are completely new. Figure 1 lists these undocumented codes.

Note that the k code can be used either to add or subtract spacing between letters. The number before the k determines the degree of tightening or loosening. Also note that with *n*u and *n*d, you can achieve superscripts and subscripts in various sizes.

Shane Devenshire
Walnut Creek, California

▶PC MAGAZINE: Lotus apparently decided not to document these codes explicitly in WYSIWYG (the Lotus version of Impress), but for compatibility with models created under Impress, 1-2-3 had to maintain their functionality.

I can think of four possible reasons why Lotus might have chosen to remain mum about some of the Impress attribute codes. First, they might not have worked consistently across the whole range of display systems that Lotus has to support. Second, they might not have worked consistently in the three versions of 1-2-3 that incorporate Impress (or Impress-like features): 1-2-3, Release 2.*x*; 1-2-3, Release 3.*x*; and 1-2-3 for Windows. Third, even

WYSIWYG In-Cell Formatting Codes for 1-2-3 2.3 and 2.4

Code	Attribute
!	Hidden
A	Font 1*
B	Font 2*
C	Font 3*
D	Font 4*
E	Font 5*
F	Font 6*
G	Font 7*
H	Font 8*
g	Fuzzy (characters formed by dots)
g	More diffuse fuzzy variants
*n*k	Kerned or letterspaced (specifies amount of kerning/letterspacing)
l	Normal*
o	Outline*
r	Rotated*
t	Thick bold
6_	Double solid strikethrough
7_	Bold solid strikethrough
9_	Dashed underline
10_	Double-dashed underline
12_	Dashed outline
13_	Dashed strikethrough
14_	Double-dashed strikethrough
17_	Dotted underline
18_	Double-dotted underline
20_	Dotted outline
21_	Dotted strikethrough
22_	Double-dotted strikethrough
25_	Long dash underline
26_	Long double-dashed underline
28_	Long dash outline
29_	Long dash strikethrough
30_	Long double-dashed strikethrough
9c	Blinking reverse
10c	Blinking red
11c	Blinking green
12c	Blinking dark blue
13c	Blinking cyan
14c	Blinking yellow
15c	Blinking magenta
16c	Blinking and hidden
1r	Rotated 90 degrees
2r	Rotated 180 degrees*
3r	Rotated 270 degrees
4r	Rotated 360 degrees (normal)*
2u	Double superscript
3u	Triple superscript
4u	Quad superscript
5u	Quint superscript
13u	Sextuple superscript
2d	Double subscript
3d	Triple subscript
4d	Quad subscript
5d	Quint subscript
13d	Sextuple subscript

*Undocumented codes that have documented equivalents.

***Figure 1:* These undocumented codes can be used for in-cell WYSIWYG formatting in 1-2-3, Version 2.3 or 2.4. Note that the codes are case-sensitive.**

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WYSIWYG In-Cell Formatting Codes for 1-2-3 for Windows

Code	Attribute
b	Bold
1c through 16c	Various colors
i	Italics
_	Underline
2_	Double underline
3_	Wide underline
4_	Solid box around text
5_	Single strikethrough
6_	Double strikethrough
7_	Wide strikethrough
9_	Dashed underline
10_	Double-dashed underline
12_	Dashed box around text
13_	Dashed strikethrough
14_	Double-dashed strikethrough
17_	Dotted underline
18_	Double-dotted underline
20_	Dotted box around text
A or 1F	Font #1
B or 2F	Font #2
C or 3F	Font #3
D or 4F	Font #4
E or 5F	Font #5
F or 6F	Font #6
G or 7F	Font #7
H or 8F	Font #8

***Figure 2:* Use these codes with the Lotus Compose facility in 1-2-3 for Windows to achieve in-cell WYSIWYG formatting. These codes are also case-sensitive.**

if the codes worked consistently across platforms and versions, Lotus might have been unwilling to maintain these features in future updates. And fourth, some of the codes might have been buggy.

In fact, reasons 1, 2, and 4 (at least) do seem to have been factors in Lotus's choosing to keep silent. Two of the blinking-color codes listed by Mr. Devenshire (10c and 12c) do not blink on my VGA (in either Release 2.4 or Release 3.4). Code 9c in Release 3.4 results in non-blinking yellow instead of a blinking reverse, 13c generates white (instead of cyan) in 1-2-3 for Windows and a salmon color in 1-2-3 Release 3.4—and so on. Moreover, while Ctrl-N (or, as we'll see in the next letter, Alt-F1 ea, in the case of 1-2-3 for Windows) seems to turn off most in-cell attributes, it does not do this correctly for the hidden (!) attribute.—*Craig Stinson*

TIP When I used to work with 1-2-3, Release 2.*x*, I made frequent use of the in-cell attribute codes provided by the Impress and WYSIWYG add-ins. I was disappointed when I moved to 1-2-3 for Windows and found that Ctrl-A did nothing but make the program beep. I pored through the manual for 1-2-3 for Windows and found no mention of the WYSIWYG formatting sequences.

Fortunately I was able to find a partial solution through the Lotus Compose (Alt-F1) facility. In place of the Ctrl-A, Ctrl-N, and Ctrl-E commands used in the DOS versions of 1-2-3, the Windows version requires Alt-F1 `ba` to begin an attribute, Alt-F1 `ea` to end attributes, and Alt-F1 `ba0` (that's a zero, not an O) to turn off a specific attribute. (Note that the Compose codes `ba` and `ea` are case-sensitive.)

Unfortunately, not all the attribute codes available in the DOS versions worked in the Windows version. Specifically, the codes for flashing (`f`), ghost characters (`1g` through `7g`), kerning/letterspacing (`nk`), outlined text (`1o` through `255o`), rotating (`1r` through `4r`), thick text (`1t` through `4t`), superscript (`u`), horizontal flip (`x`), and vertical flip (`y`) did not produce the desired effects in 1-2-3 for Windows. Figure 2 shows the codes that do work.

Thus, for example, to underline a specific word in a label, you would press Alt-F1, followed by `ba`, followed by the word you want to underline. And you would press Alt-F1 followed by `ea` at the end of the word. If you've turned on both bold and italics and want to turn off just the italics attribute after a certain word, you would press Alt-F1 followed by `ba0i` at the end of that word.

Paul D. Simon
Bridgeport, Connecticut

▶PC MAGAZINE: I can't imagine why Lotus failed to document the Compose sequences that mimic WYSIWYG's Ctrl-A, Ctrl-E, and Ctrl-N. Anyone who's ever imported a Release 2 or Release 3 file containing WYSIWYG in-cell attributes into 1-2-3 for Windows knows that those codes do get translated. So it's been quite clear that the functionality was available in 1-2-3 for Windows. But I have never found any mention of these Compose sequences in the Lotus documentation or help files. Mr. Simon's revelation should definitely prove useful to many users of 1-2-3 for Windows.

These codes, incidentally, appear to be supported to the same extent in the new 1-2-3 for Windows, Release 4, as they were in 1-2-3 for Windows, Version 1.1.—*Craig Stinson*

Databases

DICTIONARY OF FIELDS FOR FOXPRO

? In the March 17, 1992, installment of Databases, you presented a PAL script that creates a table containing all of the field structure information for tables in the current directory. Can you suggest a similar routine that would do the same thing for FoxPro tables?

Steve Weintraub
Garden City, New York

▶PC MAGAZINE: Sure. Figure 3 shows the mkfldtbl() function (which stands for *make fields table*). You can use it to create a dictionary of .DBF field information for any directory on your disk. To use the function, you pass it the name of the dictionary table in which to store the field information, as well as the directory to search, and it creates the dictionary table and populates it with field information for all of the .DBF files found in the named directory. For example, you could call it from the Command window like this:

```
=mkfldtbl('DD.DBF','C:\FP25\')
```

This creates the DD.DBF dictionary table in the current directory and fills it with field information from the .DBF files found in the C:\FP25 directory.

The routine starts by creating an array of .DBF files whose fields should be *excluded* from the dictionary. For example, mkfldtbl() assumes that you don't want to include the fields from FOXUSER.DBF or FOXHELP.DBF, and that you don't want to include the fields from the dictionary table itself. Therefore the `cexclude` array holds three names: the name of the dictionary table, "FOXUSER.DBF," and "FOXHELP.DBF." Next, FoxPro's ADIR() function is used

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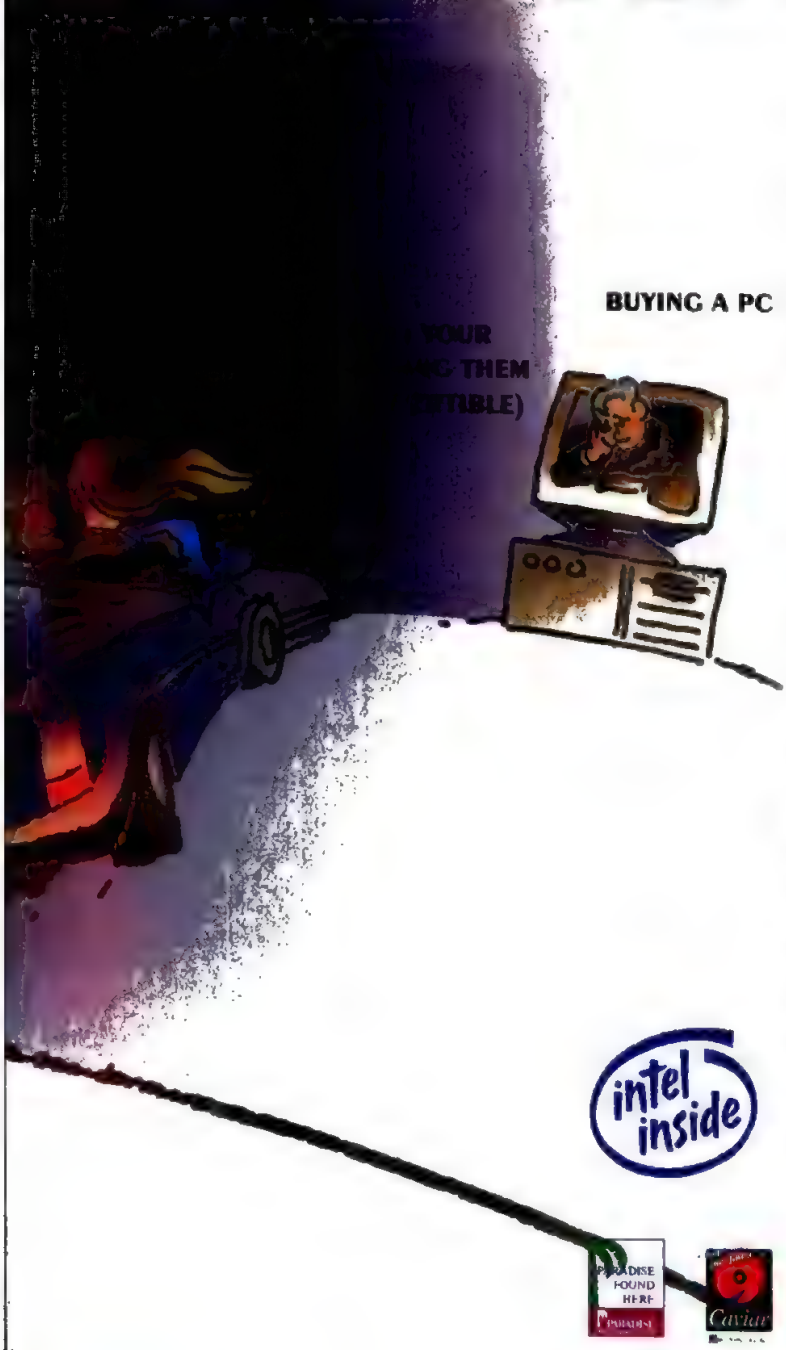

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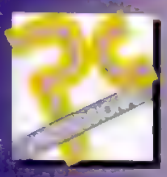

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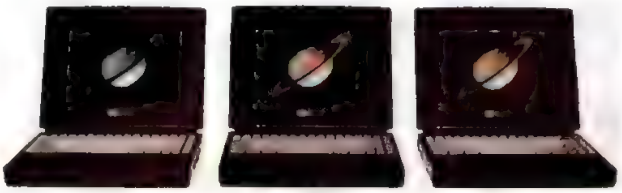

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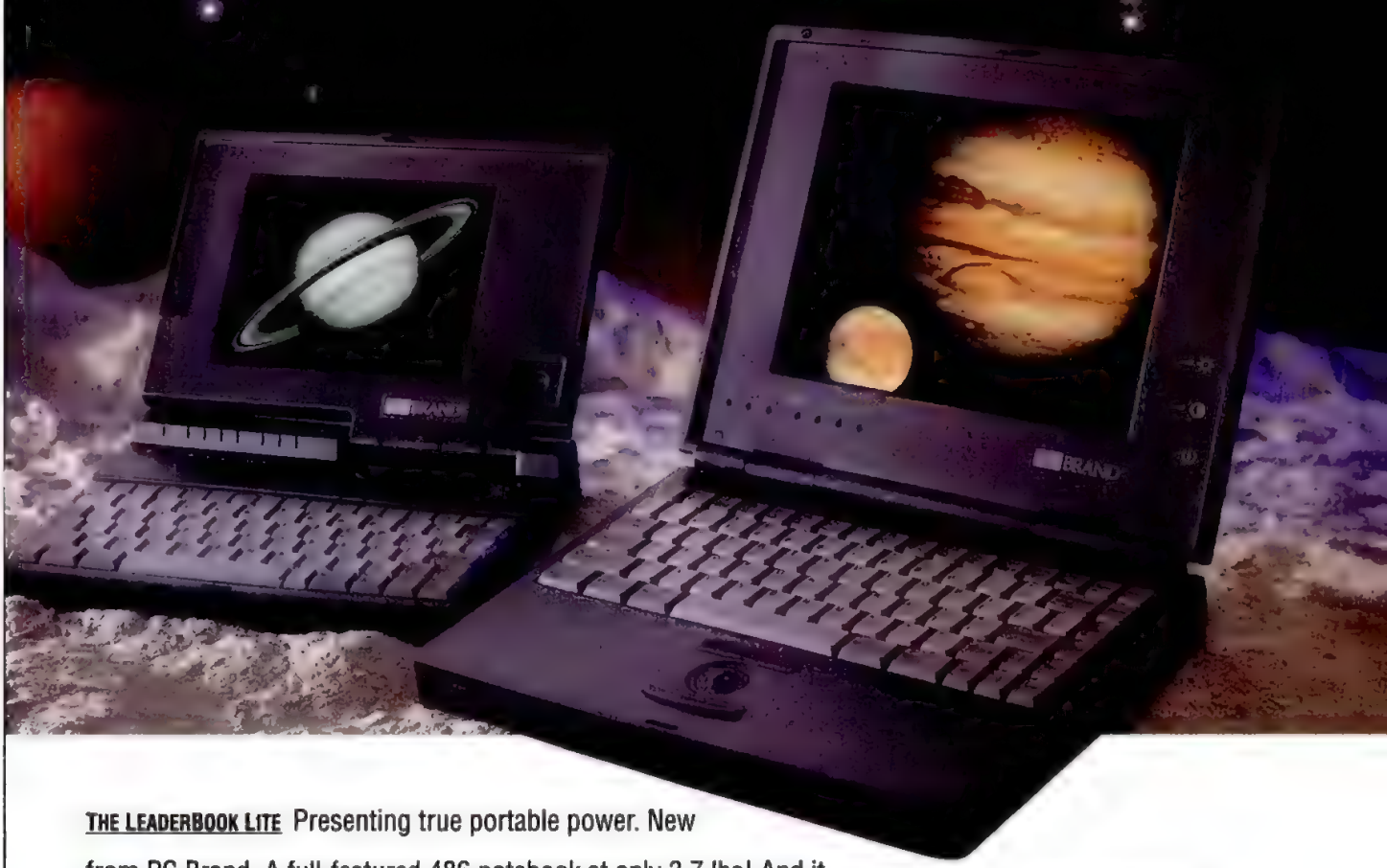

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A FoxPro Table Dictionary Function

Complete Listing

```
*****************************************************************
* FUNCTION mkfldtbl ( cTbl, cDir )
*
* Builds a dictionary table (cTbl) containing field information
* for all DBF's in the cDir directory, excluding those
* listed in the cExclude array below.
*****************************************************************
FUNCTION mkfldtbl
PARAMETERS ctbl, cdir
nexcluded = 3
DECLARE cexclude( nexcluded )        && Array of tables to exclude
cexclude(1) = nopath( ctbl )         && The dictionary table
cexclude(2) = "FOXUSER.DBF"          && The FoxPro resource file
cexclude(3) = "FOXHELP.DBF"          && The FoxPro help file

ndbfcount = ADIR( cdbfs, cdir + "*.DBF" )
IF ndbfcount == 0
   WAIT WINDOW "No tables to process" NOWAIT
   RETURN .F.
ENDIF
*
* Remove excluded tables
*
FOR x = 1 TO nexcluded
   nelement = ASCAN( cdbfs, cexclude(x) )
   IF ( nelement != 0 )
      nrsub = ASUBSCRIPT( cdbfs, nelement, 1)
      t = ADEL( cdbfs, nrsub )
      IF t == 1
         ndbfcount = ndbfcount - 1
      ENDIF
   ENDIF
ENDFOR
RELEASE x, nelement, nrsub, t, nexclude, nexcluded

IF FILE(ctbl)
   IF !overwrit()
      WAIT WINDOW "Cancelled" NOWAIT
      RETURN .F.
   ENDIF
ENDIF
*
* Create dictionary table
*
oldsafety = SET('SAFETY')
SET SAFETY OFF
CREATE TABLE ( ctbl ) ;
   ( dbfname C(8),      ;
   fldname C(10),       ;
   fldtype C(1),        ;
   fldlen N(3),         ;
   flddec N(3))
SET SAFETY &oldsafety
calias = ALIAS()
*
* Load dictionary table
*
savdef = SYS(5) + CURDIR()
SET DEFAULT TO ( cdir )
FOR x = 1 TO ndbfcount
   SELECT 0
   USE ( cdbfs( x, 1 ) ) AGAIN
   nflds = AFIELDS( cdbstruct )
   USE
   SELECT (calias)
   FOR y = 1 TO nflds
      APPEND BLANK
      REPLACE dbfname WITH LEFT(cdbfs(x,1),AT(".",cdbfs(x,1))-1)
      REPLACE fldname WITH cdbstruct( y,1 )
      REPLACE fldtype WITH cdbstruct( y,2 )
      REPLACE fldlen  WITH cdbstruct( y,3 )
      REPLACE flddec  WITH cdbstruct( y,4 )
   ENDFOR
ENDFOR
*
* Create dictionary index tags
*
SELECT (calias)
INDEX ON dbfname TAG dbfname
INDEX ON fldname TAG fldname
INDEX ON fldtype TAG fldtype
INDEX ON fldlen TAG fldlen
INDEX ON flddec TAG flddec
USE
SET DEFAULT TO (savdef)
RETURN .T.

*****************************************************************
* FUNCTION nopath
* Return filename.ext portion of filespec by
* removing the drive and path
*****************************************************************
FUNCTION nopath
PARAMETER filespec
N = RAT( '\',filespec )
IF N <> 0
   filespec = IIF( N=0,filespec,SUBSTR(filespec,N+1) )
ELSE
   N = RAT(':',filespec)
   IF N <> 0
      filespec = IIF( N=0,filespec,SUBSTR(filespec,N+1) )
   ENDIF
ENDIF
RETURN filespec

*****************************************************************
* FUNCTION overwrit                          FoxPro for Windows
* Display File Existe alert message and * get .T. or .F. overwrite
* permission
*****************************************************************
FUNCTION overwrit
cYesno = "No"
DEFINE WINDOW overwrit AT 0.000, 0.000 SIZE 6.385,35.000 ;
    FONT "MS Sans Serif", 8 STYLE "B" FLOAT NOCLOSE ;
        NOMINIMIZE DOUBLE
MOVE WINDOW overwrit CENTER
ACTIVATE WINDOW overwrit
@ 1.077,3.167 SAY "File already exists. Overwrite?"  ;
        FONT "MS Sans Serif", 8 ;
        STYLE "B"
@ 3.846,3.000 GET cYesno PICTURE "@*HT \!\<Yes;\?\<No" ;
        SIZE 1.769,14.000,1.000 ;
        FONT "MS Sans Serif", 8 ;
        STYLE "B"
READ CYCLE
RELEASE WINDOW overwrit
RETURN IIF(cYesno=="Yes", .T., .F.)
```

Figure 3: **The mkfldtbl() function creates a table containing field information for all of the .DBFs in the specified directory.**

to create an array containing the names of all of the .DBF files in the directory to be searched. This array, which is called `cdbfs`, is then searched for the files that are listed in the `cexclude` array. If any are found, they are removed from the array.

The dictionary table is then created using the CREATE TABLE command (if one already exists, mkfldtbl() displays a prompt indicating this). Then for each .DBF in the array of tables to process, the .DBF is opened, the AFIELDS() function is called to obtain the table structure information, and that information is placed in the dictionary table.

The routine concludes by creating index tags for each of the fields in the dictionary table before returning to the calling program or the Command window.

The mkfldtbl() function forms the basis for BUILDD.SPR, a screen program I created using the FoxPro Screen Builder. Figure 4 shows the program's main dialog. To run the program, select the Command window and enter

```
DO BUILDD.SPR
```

The BUILDD program displays a dialog that lets you select the directory to search and the dictionary table name, and whether to show the results in a Browse window (shown in Figure 5) or in a report. You can choose to order the results by field name or by table name, and if you choose to send the results to a report, you can also choose between preview mode or sending the report to the printer. Viewing the results in field name order can be helpful because it lets you pinpoint all of the tables that use the same field name.

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Source: 486/66DX2 Review from PC World, Computer Shopper Jan. July, 1993.

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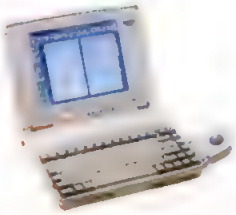

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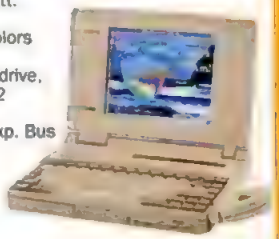

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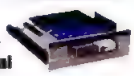

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CODE # PM09A3

CIRCLE 051 ON READER SERVICE CARD

Figure 4: **BUILDD.SPR presents a dialog box that lets you choose the directory to process and the table to use for the dictionary of fields. You can show the results in a Browse window or in a report.**

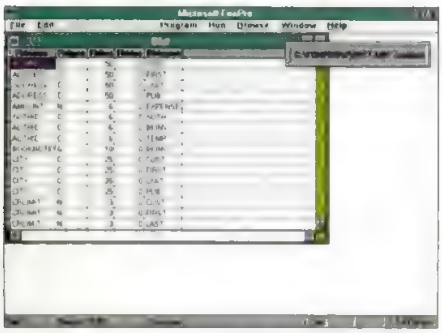

Figure 5: **You can display the fields in table order or in field order, in a Browse window or in a report.**

As long as you keep all of your application's database files in a single directory, the BUILDD program can be a very handy way to quickly produce a listing of all of your application's field names and types.

Incidentally, at the bottom of Figure 3 are two routines used by mkfldtbl() that you might find useful in other contexts. The first, `nopath`, removes the drive and path from a file specification, returning only the 12 characters of the filename and extension. The second, `overwrit`, displays a dialog on the display with the message "File already exists. Overwrite?" You can then choose Yes to overwrite the file or No if you don't want to overwrite the file. The function returns `.T.` if you choose Yes, and it returns `.F.` if you choose No.

The BUILDD program can be downloaded from PC MagNet. Look for the file BUILDW.ZIP in the Spreadsht/DBMS section that appears in the Utilities/Tips Forum (GO TIPS). In addition, a similar version for FoxPro for DOS is available in BUILDM.ZIP.

—Sal Ricciardi

Graphics

USING TRUETYPE FONTS WITH ALDUS FREEHAND

? I use FreeHand 3.1, and even though the TrueType fonts installed on my system appear on the type menu, I can't get them all to print properly on my PostScript printer. Some, like Arial, seem to print out just fine. But others cause two different problems. If I use a TrueType font in a simple text block, I sometimes get Courier instead of the TrueType font I've chosen. And if I align text to a curve, nothing prints out at all—there's just a blank area where the type should be. Can you explain what's happening?

John McAlley
New York, New York

▶PC MAGAZINE: Aldus FreeHand does support TrueType fonts but, at least for now, only if you're printing to a non-PostScript printer. So if you work with an HP LaserJet-compatible printer and PCL drivers, you'll have no problems printing TrueType fonts—even type that has been rotated or aligned to a curve will print without a hitch.

Currently there is a compatibility problem between FreeHand's implementation of TrueType fonts and the Windows printer driver, causing TrueType fonts to literally disappear when printed to a PostScript device. The Aldus tech support staff confirmed the existence of this problem, and they're working on a solution. For more information you can contact Aldus directly at 206-628-4532. In the meantime, to print your TrueType designs to a PostScript printer, try one of the following workarounds.

The easiest solution—and the one I'd recommend—is to simply convert the text to a path (which is how FreeHand refers to freeform curves). In most cases you'll want to generate any special effects while the words are still in text form. For example, you can align the TrueType text to a path and then use FreeHand's kerning tools to adjust the positions of individual characters. At this stage you can also change the font, point size, type style, or even the spelling of the words.

After you've finalized your design, open the Type menu and choose the Convert to Path command. Once you issue this command, the letters on-screen are no longer text elements; they are stored as a series of line and curve segments and so will print out just like any other drawn element. But this also means that they can no longer be edited as text—you can't correct spelling errors, change the font, or kern the individual letter shapes.

One final suggestion: Format these letter shapes with a solid fill and a stroke (or outline) of either none or hairline. You'll want the thinnest possible outline in order to keep the shape of the letter clean and legible. Unless your type is very large, heavier outlines will probably interfere with the letters' strokes. That is, fine details like serifs (small curves that appear at the ends of strokes) and counters (the holes in letters like b or p) will be obscured by thick lines.

If you're more ambitious, or must absolutely work in text mode, you can try an alternate—and slightly trickier—solution. Rather than sending the file directly to your PostScript printer, print to disk instead. This is the normal procedure when you plan to send a PostScript file to a service bureau. When you print a PostScript file to disk, the Windows printer driver embeds the necessary font information in the file, ensuring that the appropriate fonts will be available at an off-site service bureau.

Unfortunately, FreeHand doesn't offer a print-to-disk option, so you'll have to create a virtual printer port using the Windows Control Panel. Here's how.

In the Control Panel, double-click the printer icon. Highlight your PostScript printer and click the button labeled *Connect.* In the Connections dialog box, scroll through the Ports list box and select the File option instead of your usual port, such as LPT1 or COM1. Click OK, then Close. Windows will now redirect output for this PostScript printer to a file and, whenever you print to this printer, you'll be prompted to supply a path and filename.

Back in FreeHand, open the document containing the TrueType fonts. Issue the Print command from FreeHand's File menu. Click on the Printer Setup button and double-check to be sure that the

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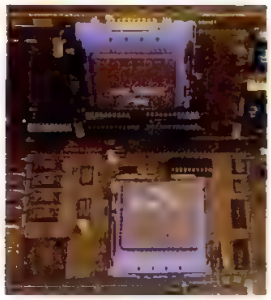

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CIRCLE 305 ON READER SERVICE CARD

PostScript printer connected to File is selected as the current printer. Click OK, then OK again to begin printing the file. This is when Windows asks you for a path and filename. Whatever filename you choose, be sure to add an appropriate extension (like .PRN) so you can clearly identify this as a printer file.

After the file has been "printed" to disk, either open DOS in a Window or exit to DOS and issue the following command:

```
copy [path]\[filename].prn lpt1:
```

Of course, you should substitute the actual directory location and name of your file, and the correct port. The file will be copied to your PostScript printer and will generate the TrueType fonts correctly.

Note that this technique is highly dependent upon the version of the Windows PostScript driver you're using. In fact, I couldn't get it to work until I updated the Windows PostScript driver from Version 3.5 to Version 3.55. You can download the latest PostScript driver from either CompuServe (GO MSL) or from Microsoft's own bulletin board (206-936-6735).

Finally (to prove that there is an explanation for everything), I did discover why some of your TrueType fonts seem to work, while others don't. The basic TrueType fonts that ship with Windows, specifically Arial and Times New Roman, are listed in your WIN.INI file alongside suitable PostScript substitutions. It isn't that Windows is printing Arial properly, it's that Windows is using Helvetica (a font that is always resident in a PostScript printer) as a substitution for Arial. And whenever Windows can't find an appropriate substitution, it uses Courier instead.—*Luisa Simone*

Networking

ADDING A PRINTER TO THE LAN

❓ We run NetWare over thin Ethernet and would like to be able to put a networked printer in our warehouse without placing a computer there. Does a reliable and easily installed product exist that can meet our requirements?

Bill Bose
Seattle, Washington

▶**PC MAGAZINE:** In our January 26, 1993, issue, we published a review of 18 products of various types that can help you set up remote printers, but you'll want to focus on the external hardware devices. These have a LAN cable connection on one end and attach to the printer's parallel port on the other. You make the physical connections, run Novell's PCONSOLE management software, select REMOTE/UNKNOWN under the Print Server Configuration menu, run a utility program supplied by the manufacturer of the print server, and the printer is ready. This solution meets your requirements for simplicity and reliability.

Wiring hubs with chassis and backplanes seem very costly, but if you don't pay for the expansion capability in the beginning, you may well have to shell out the extra bucks later.

You will encounter one possible drawback with hardware print servers—each remote printer counts as a user on the server, so if you're almost out of NetWare user licenses you could face an expensive upgrade.

Since the article was published, two important companies—Pacific Data and Xircom—have come out with external print servers. The $499 Xircom Pocket Ethernet Print Server steps squarely into the NetWare IPX market and competes with products from ASP Computer Products, Digital Products, and Extended Systems. You'll have to order a specific version for either thin Ethernet or 10BaseT cabling. The device sits outside the printer and connects to the parallel port, so it's compatible with many different printers and plotters. Contact Xircom at 800-438-9472 or 818-878-7600 for more information.

Pacific Data Products' DirectNet doesn't have that universal appeal—instead, it slides inside most models of HP printers. It does have some special talents, though. The $499 adapter works with either thin Ethernet or 10BaseT and is designed for NetWare's IPX protocols. People with networks that combine both the IPX and IP protocols—perhaps networks that mix PCs running NetWare with Sun and IBM workstations or those where some nodes use IP across routers—will appreciate the $699 DirecNet that responds to either IPX- or IP-directed print jobs. This product makes the printer available to people running a variety of network operating systems and applications. If you would like more information, contact Pacific Data at 619-552-0880.—*Frank J. Derfler, Jr.*

3COMS's STACKABLE HUBS EASE LAN PLANNING

❓ Several of our clients ran into problems when they tried to expand their 10BaseT networks, because they had initially purchased wiring hubs with limited numbers of ports. As the networks grew, the clients added more hubs, but then they ran into the Ethernet "three repeater rule." Can you suggest any alternative to throwing away those closed boxes and spending more money for chassis hubs that can be expanded?

Bill Wilton
Dallas, Texas

▶**PC MAGAZINE:** Many people have been painfully caught by the three-repeater rule. Small wiring hubs with a fixed number of ports are inexpensive, while hubs with a chassis and a backplane seem very costly. However, you can daisy-chain only three Ethernet repeaters (hubs) before you run into the likelihood of creating endless collisions when nodes send out very small packets. On the other hand, if the 10BaseT modules are connected by a backplane (as they are in chassis-type hubs) then each chassis-type hub appears as one repeater on the Ethernet network. This is a classic case of "Pay me now or pay me later:" If you

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- 4 or 8MB RAM expandable to 20MB
- MS-BallPoint/QuickPort
- MS-DOS, Windows 3.1

Screen	RAM	Hard drive	Price
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Passive	8MB	200MB	$3649
Active	4MB	200MB	$4299

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- 4MB RAM expandable to 20MB
- 64KB cache
- MS-DOS, Windows 3.1
- Trackball

Screen	Hard drive	Price
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Active Color	120MB	$3199

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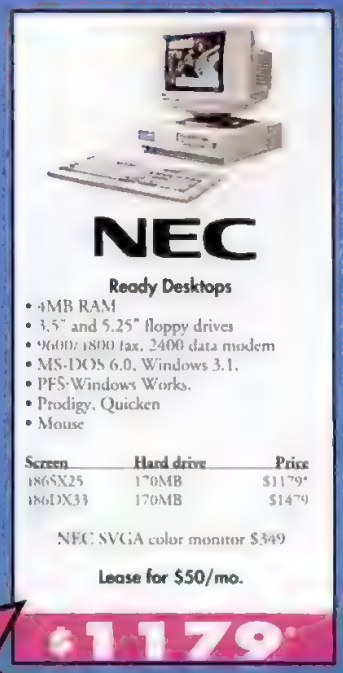

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- PFS-Windows Works,
- Prodigy, Quicken
- Mouse

Screen	Hard drive	Price
486SX25	170MB	$1179*
486DX33	170MB	$1479

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$1179*

NEC

UltraLite Versa

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- Local bus graphics
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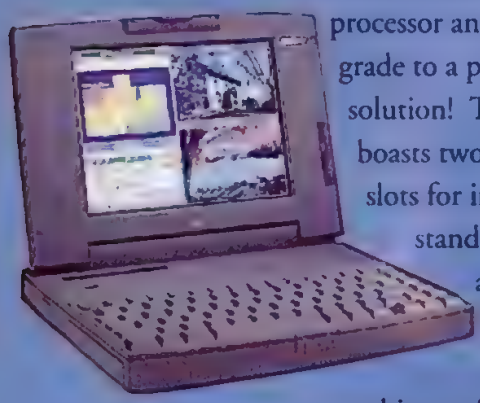

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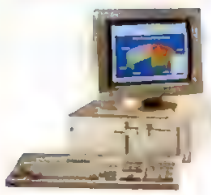

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- 8KB cache expandable to256KB
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486DX/33	170MB	$1239
486DX33	260MB	$1349
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Model	123/W	213/W	Price
4/25s	120MB		$1029*
4/33	120MB	—	$1299
4/33		210MB	$1539
4/66d		210MB	$2699

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- 3.5" floppy drive
- Local Bus graphics
- MS-DOS 6.0, Windows 3.1, Mouse

Model	Hard drive	Price
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486SX25	240MB	$1299
486DX33	120MB	$1489
486DX33	240MB	$1679
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AST

Bravo LP

- "Green" PC
- 486 processor
- Accelerated local bus graphics
- Local Motion video capability
- Pentium/Overdrive upgradable
- MS-DOS 6.0, Windows 3.1, Mouse

Model	RAM	Hard drive	Price
4/25s	4MB	170MB	$1179*
4/33	4MB	170MB	$1449
4/33	8MB	340MB	$1899
4/66d	8MB	340MB	$2999

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DESKPRO/i 4/25is

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- 4MB RAM
- 120MB hard drive
- 3.5" floppy drive
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- Business audio
- MS-DOS, Windows 3.1, mouse

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DESKPRO/M

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- Intelligent modularity
- QVision graphics controller
- MS-DOS, Windows 3.1, mouse

Processor	Hard drive	RAM	Price
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486DX33	120MB	4MB	$2469
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don't pay for the expansion capability in the beginning, you may well have to shell out the extra bucks later.

The same holds true for network management. Many people don't believe they will ever need network management—until they have a spectacular failure. Then, in order to install managed hubs in their networks, they often must throw away their existing equipment.

However, there is a middle ground for conservative LAN planners. 3Com pioneered a line of stackable 10BaseT wiring hubs, and companies like Asante market competing products. These fixed hubs have an external connection that acts like a backplane. You can connect short, thick cables between these hubs, and then each stack will appear as a single repeater. The lower-cost hubs in these families of products don't have a full management information base, but they can be managed by a more capable member of the family. So by investing a few more dollars per port in the beginning, your network can grow into an expandable and manageable system of wiring hubs.—*Frank J. Derfler, Jr.*

Languages

ADDRESSING HUGE ARRAYS IN C

❓ I would like to buy a PC with several megabytes of extra RAM and then a C compiler that would let me address arrays of almost any size; let's say up to 2MB in one array.

Presumably OS/2 2.0 allows such a program to run. Is there any way to do it under Windows? What C compilers would do it?

A.F.R. Brown
Palo Alto, California

▶**PC MAGAZINE:** The quick answer is yes, there is a way to access arrays of 2MB in a Windows program. Unfortunately, it is not as simple as it might be. Any discussion of C pointers on PC-compatible computers must begin with a short history lesson.

The microprocessor in the original PC was an Intel 8088. Like its sister processor, the 8086, the 8088 could access an incredible (at the time) 1MB of memory space. To allow the microprocessor to access the full 1MB with registers only 16 bits wide, Intel developed its segment: offset design. The segment register, containing the paragraph (byte address times 16) address, was added to the offset register to produce a 20-bit address. The 16-bit wide offset limited the segment size to 65,536, but programs got around this problem by simply adding values to the segment register to reach data beyond the 64K segment limit.

The release of the 80286 introduced *protected mode.* In protected mode, the segment register no longer contained a physical address. Instead it contained a pointer to a table of segment descriptors.

Both Microsoft's and Borland's C compilers include the* huge *modifier, which can be used to tell the compiler to perform the proper segment arithmetic.

Each descriptor contained the base address of the segment along with its size (which was still limited to 64K) and access methods. While the 286's protected mode allowed programs to access up to 16MB of RAM, it was incompatible with the now-dubbed *real mode* of the 8088. DOS programs that used to simply add a number to the segment register to point to a new address wouldn't work in protected mode.

When IBM and Microsoft developed OS/2 1.*x*, they had to solve the problem of working with memory blocks larger than 64K. The solution they came up with was to allocate what are called *huge* blocks—memory blocks larger than 64K—as a series of 64K segments with consecutive entries in the segment descriptor table. A program needing to access memory beyond a 64K offset into the block would add some magic number to the segment register value to make it point to the next entry in the descriptor table. An operating system call was created so that a program could determine what increment value to use when adding to the segment value.

If a program asked for 2MB of RAM (2,048K), OS/2 would allocate 32 segments, each 64K in size. The segment descriptors for these 32 segments would be in consecutive entries in the segment descriptor table. OS/2 would return the value of the first segment in the table. The program would call OS/2's DosGetHugeShift() API function to obtain the value to add to the segment value in order for it to point to the next entry in the descriptor table.

For example, to access offset 965K inside the 2MB block, a program would divide 965K by 65,536, resulting in 14 with 47,496 as the remainder.

This means that the 965K offset would be in the fourteenth segment at offset 47,496. The offset could then be accessed by multiplying the HugeShift value by 14, adding it to the base selector value and placing the result in a segment register. The 47,496 would then be the offset in that segment.

Working with huge memory blocks in Windows 3.*x* is similar to OS/2 1.*x*. Both systems use the 80286 protected-mode segment model for managing memory. Both also use the consecutive entries trick to work with huge segments. Instead of determining the huge shift by using a call to the operating system, a Windows program uses the variable _AHINCR exported from the Windows KERNEL DLL. _AHINCR is the value to add to a selector to make it point to the next 64K segment.

The code fragment shown in Figure 6 allocates a 1MB global memory block and then fills the block with 5s. Notice that the value of _AHINCR is determined by using the GetProcAddress function.

The example in Figure 6 is quite involved. Fortunately, there is a simpler method of working with huge memory blocks. Both Microsoft's and Borland's C compilers include the huge modifier, which can be used to tell the compiler to perform the proper segment arithmetic. Here's how the example in Figure 6 looks when you use a huge pointer:

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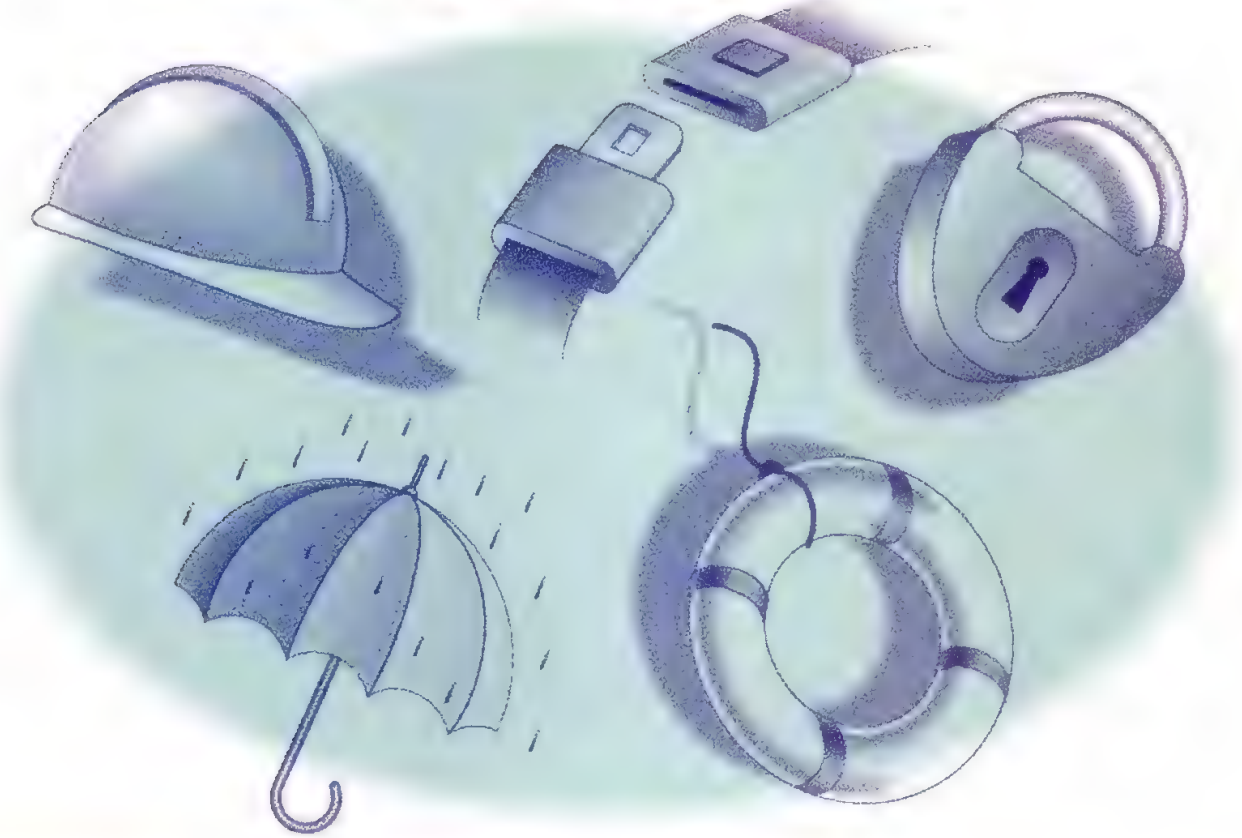

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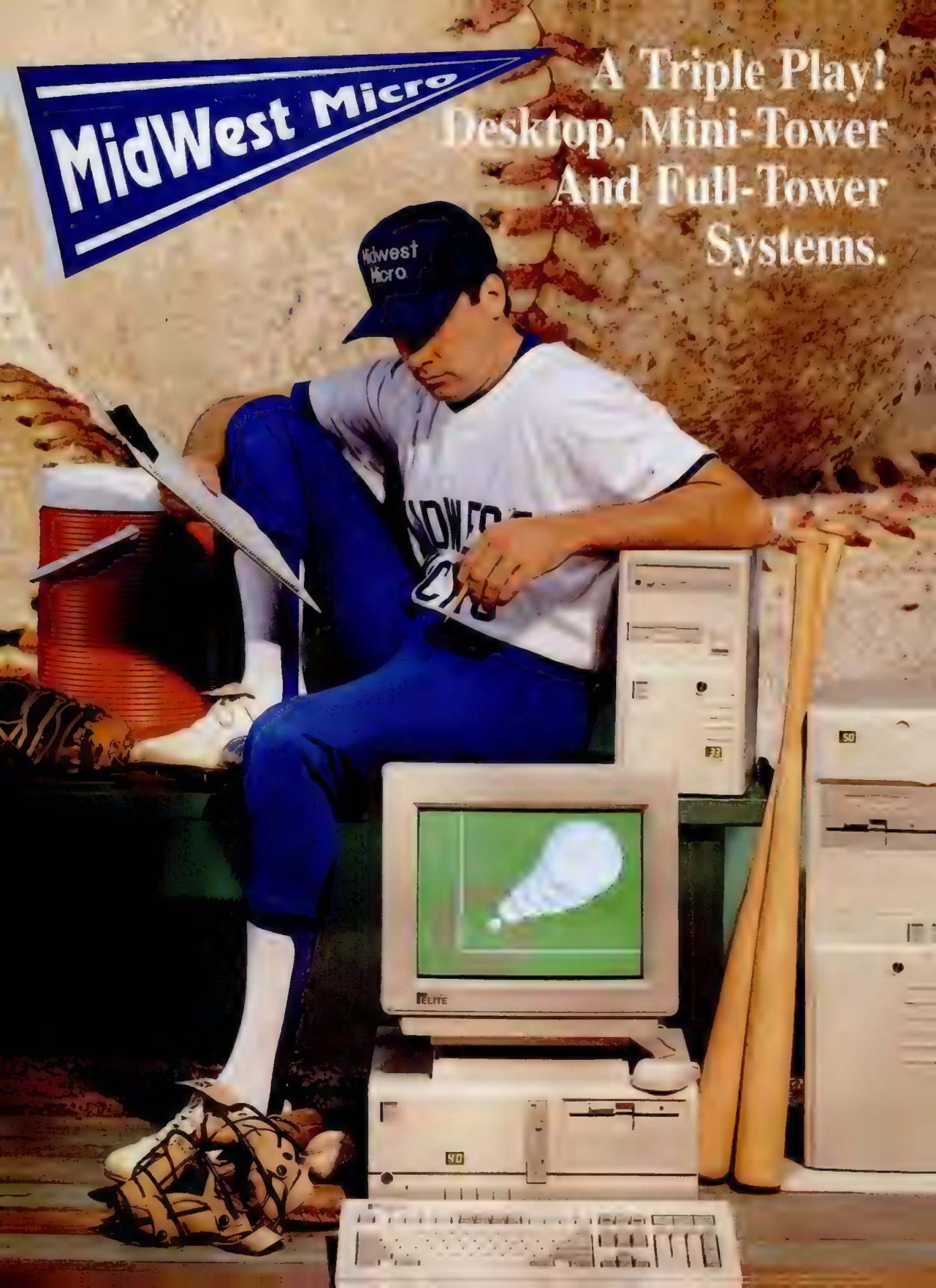
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- 130 Mb IDE Hard Drive
- 1.44 Mb 3.5" Floppy Drive
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- 14" SVGA .28 Non-Interlaced Color Monitor
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- 1.2 Mb 5.25" Floppy Drive
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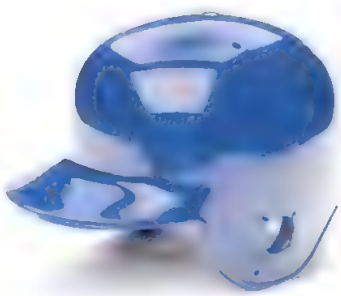

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Color - 9", 256 colors
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Take Me Out To The Ball Game

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You'll never run out of storage space with the Elite Subnote. Once you fill its 80 Mb removable hard drive, simply take it out and insert another hard drive. There's no limit to the number of hard drives you can fill...or files you can save.

You'd think a small sub notebook would be hard to work on—but it's not. The Elite Subnote rounds out its bases with a 7.4" high-contrast screen that displays 640 x 480 VGA resolution and 64 gray shades.

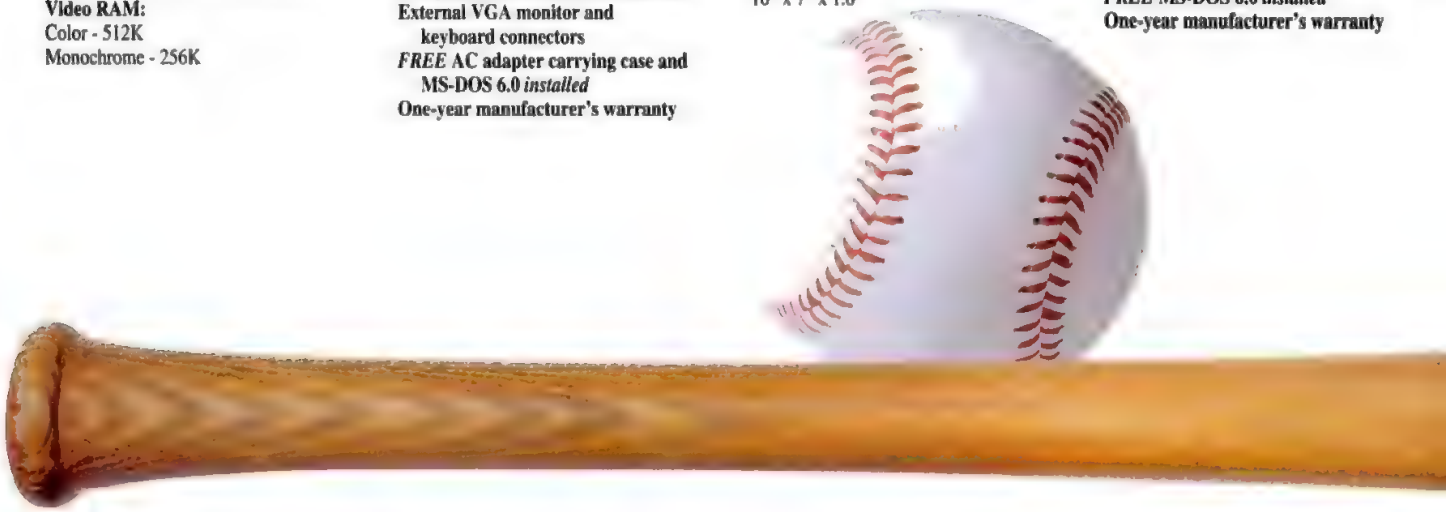
Elite 486SLC-33 Subnote

Model	Item #	Price
80 Mb	005415	$1359

Statistics:

Processor:
Cyrix 486SLC
Processing Speed:
33 MHz
RAM:
2 Mb RAM, expands to 8 Mb
Hard Drive:
Removable 80 Mb hard drive
Screen:
7.4" high-contrast screen
640 x 480 VGA resolution
64 gray shades
Video RAM:
256K
Weight:
3.7 lbs. with battery
Size:
10" x 7" x 1.6"

Battery:
Nickel metal hydride battery
Up to eight hours with APM*
Keyboard:
79-key with 101-key emulation
Built-in 2-button trackball
Drag button
Interfaces and Ports:
Parallel and serial interfaces
External keyboard, monitor and modem connectors
External floppy port
PCMCIA Type II slot
Advanced Power Management
Simultaneous video
***FREE* external 3.5" 1.44 Mb floppy drive, AC adapter and utilities support disk**
FREE* MS-DOS 6.0 *installed
One-year manufacturer's warranty



*Battery life measured with Power Management enabled. Actual battery life may vary.

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Everyone loves our new line of Elite 486 Notebooks. Choose your Elite with an Intel 486SX-25, 486DX-33 or 486DX2-50 processor, select an active color, dual-scan color or monochrome screen and then pick the hard drive that best meets your needs—from 80 Mb up to 200 Mb!

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Isn't it a relief to know that whether you're a teacher, doctor, lawyer, sales representative, student or homemaker, there's an Elite 486 Notebook perfectly matched to your needs...*and* your budget?

Statistics:

Processor:
Intel 486SX-25, 486DX-33 or 486DX2-50
RAM:
4 Mb, expands to 20 Mb
Hard Drive:
80 Mb, 120 Mb or 200 Mb
Screen:
10", 640 x 480 VGA resolution
Backlit display
Color - 256 colors
Monochrome - 64 gray shades
Battery Life*:
Active Color - 3 hours
Dual-Scan Color - 4 hours
Monochrome - 6 hours

Weight:
Color - 6.9 lbs.
Monochrome - 6.4 lbs.
512K Video RAM
86 keys with 101-key emulation
Built-in trackball
Built-in 1.44 Mb, 3.5" floppy drive
Advanced Power Management
One parallel and one serial port
External VGA and keyboard connectors
One PCMCIA Type III slot/ two Type II slots
***FREE* AC adapter and utilities disk**
***FREE* MS-DOS 6.0 installed**

486SX-25 Elite Notebooks

	Monochrome	Dual-Scan Color	Active Color
80 Mb	$1599 #005500	$2339 #005505	$3219 #005510
120 Mb	$1649 #005501	$2389 #005506	$3269 #005511
200 Mb	$1739 #005502	$2489 #005507	$3369 #005512

486DX-33 Elite Notebooks

	Monochrome	Dual-Scan Color	Active Color
80 Mb	$1869 #005515	$2599 #005520	$3489 #005525
120 Mb	$1919 #005516	$2659 #005521	$3539 #005526
200 Mb	$1999 #005517	$2749 #005522	$3629 #005527

486DX2-50 Elite Notebooks

	Monochrome	Dual-Scan Color	Active Color
80 Mb	$2089 #005530	$2839 #005535	$3719 #005540
120 Mb	$2139 #005531	$2889 #005536	$3759 #005541
200 Mb	$2239 #005532	$2979 #005537	$3859 #005542

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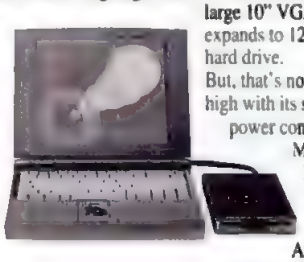
If you're looking for a powerful portable, the Elite 486SX-25 Subnote is a great catch. Weighing a mere 3.9 lbs., the 486SX-25 Subnote features a large 10" VGA screen, 4 Mb of RAM that expands to 12 Mb and up to a 200 Mb hard drive.



But, that's not all! The Elite Subnote scores high with its special Intel processor for low power consumption, Advanced Power Management and PCMCIA Type II slot for modems, flash memory, network adapters and more.

All this for under $1500? Only at MidWest Micro—so call us today and get your Elite Subnote for peanuts.

486SX-25 Subnote

Model	Item #	Price
80 Mb	005575	$1499
120 Mb	005576	$1549
200 Mb	005577	$1639

Statistics:

Processor:
Intel 486SX
Processing Speed:
25 MHz
RAM:
4 Mb expands to 12 Mb
Hard Drive:
80 Mb, 120 Mb or 200 Mb
Screen:
10", 640 x 480 VGA resolution
Backlit display
64 gray shades

Battery Life*:
5 hours
Weight:
3.9 lbs.
512K Video RAM
83 keys with 101-key emulation
Built-in trackball
External 1.44 Mb, 3.5" floppy drive
Advanced Power Management
One parallel and one serial port
External VGA and keyboard connectors
One PCMCIA Type II slot
***FREE* AC adapter**
***FREE* MS-DOS 6.0 installed**

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CIRCLE 398 ON READER SERVICE CARD

Allocating Huge Memory Blocks in Windows 3.x

```
#define   MEMSIZE    1048576
#define   ERR_NOMEM  -1

HGLOBAL GetMem (void) {
        HANDLE hGlobal;
        WORD i, wSeg, wOffset, wLimit, wSegInc;
         char far *lpPtr;
        DWORD dwMemSize;

        hGlobal = GlobalAlloc (GHND, MEMSIZE);
        if (hGlobal == NULL)
                return ERR_NOMEM;
        lpPtr = GlobalLock (hGlobal);

        wSegInc = LOWORD (GetProcAddress (GetModuleHandle ("KERNEL"),
                "_AHINCR"));
        wSeg = HIWORD ((DWORD)lpPtr);
        wOffset = LOWORD ((DWORD)lpPtr);
        dwMemSize = MEMSIZE;
        do {
                lpPtr = (LPBYTE)((((DWORD) wSeg) << 16) + wOffset);

                wLimit = (WORD) (dwMemSize % 65536);
                for (i = 0; i < wLimit; i++)
                        *lpPtr++ = 5;
                wSeg += wSegInc;
                wOffset = 0;
                dwMemSize -= wLimit;
        } while (dwMemSize > 0);
        GlobalUnlock (hGlobal);
        return hGlobal;
}
```

Figure 6: **This code fragment demonstrates how to allocate a 1MB global memory block by exporting the variable _AHINCR from the Windows KERNEL.**

```
#define   MEMSIZE    1048576
#define   ERR_NOMEM  -1

HGLOBAL GetMemH (void) {
        HANDLE hGlobal;
        char huge *lpPtr;
        DWORD i;

        hGlobal = GlobalAlloc (GHND,
                MEMSIZE);
        if (hGlobal == NULL)
                return ERR_NOMEM;

        lpPtr = GlobalLock (hGlobal);

        for (i = 0; i < MEMSIZE; i++)
                *lpPtr++ = 5;

        GlobalUnlock (hGlobal);
        return hGlobal;
}
```

As you can see, the C source is vastly simplified. The segment-handling code is still there, but it's handled automatically by the compiler. There are limits to using huge pointers. Variables and structures stored in huge memory blocks cannot cross segment boundaries. Refer to your compiler manuals for limitations specific to your compiler.

OS/2 2.0 uses another method for managing huge memory blocks. OS/2 2.0 takes advantage of the ability of the 80386 processor to make segments any size. Segments still exist in OS/2 2.0, but they are almost completely hidden by the operating system. When a program starts, OS/2 allocates segments for the code and data. The size of the data segment is set to the size of the virtual memory of the machine. This way a program never has to bother with segments, since any of the 32-bit registers of the 80386 can be used to access any offset within the address space.

However, 32-bit segments are no panacea. Intel 32-bit code is larger than its 16-bit cousin, because offsets and immediate values are twice the size—4 bytes instead of 2. Pushes and pops on the stack are also 4-byte operations in 32-bit segments. On underpowered machines, especially those using 386SX processors, 32-bit code can easily be slower than 16-bit code.

Deciding to write 32-bit flat code or 16-bit segmented code is a programming decision that must be made on a case-by-case basis. Flat code allows simple access to arrays of almost unlimited size. On the other hand, 16-bit segmented code tends to be smaller and faster, especially when there is no need to access vast amounts of data. While it may not be "cool" to write 16-bit code these days, there is no doubt that it still has its place.
—Douglas Boling

On-line

IDENTIFYING USER IDs ON COMPUSERVE

▶**PC MAGAZINE:** Every member of CompuServe or ZiffNet has a user ID number, and for the most part these numbers convey no more meaning than a telephone number. But frequent users of these on-line services will begin to notice a few particular sequences of numbers within the user IDs that seem to have special meanings. Numbers that begin with 7670 always seem to belong to sysops, for example. In fact there are a handful of user ID codes that are reserved for special purposes. There's no official directory of these magic numbers, but I've managed to identify quite a few of them:

7000*x*	CompuServe
72241	ZiffNet and PC Magazine
72511	ZiffNet/Mac
72631	PC Week
75300	Vendors, developers, press, and so forth
76000	PC/Computing
76004	Same as 75300
7670*x*	Sysop
10*xxx*	International

When chatting electronically, you miss the vocal and physical cues of a face-to-face conversation, so every tiny clue you can gather about the person you're communicating with is valuable. Knowing these special numbers can give you just a little extra information about your on-line correspondents! □
—Neil J. Rubenking

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Mono	200MB	$2049
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T4600

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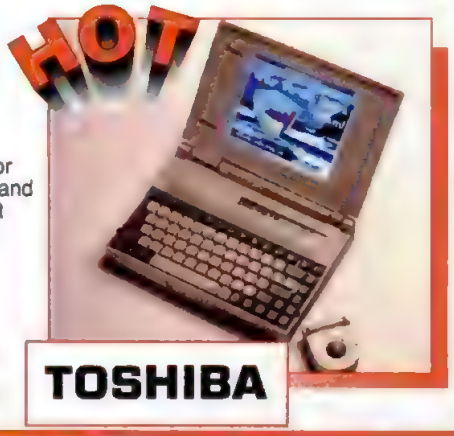

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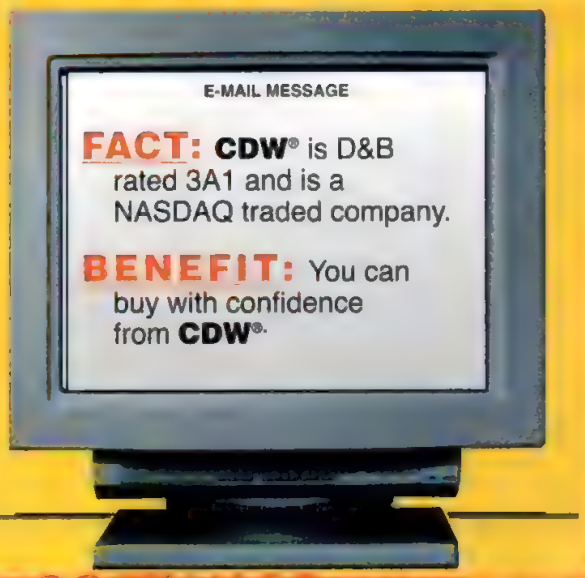

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COMPAQ DP 386/33 4MB	[illegible]
COMPAQ [illegible] 4MB	[illegible]
COMPAQ [illegible] 4MB	[illegible]
COMPAQ [illegible] 8MB	[illegible]
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COMPAQ [illegible] 4MB	[illegible]
COMPAQ [illegible] 8MB	[illegible]
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TI MICROLASER 1MB	[illegible]
TI [illegible] 8MB	[illegible]
TI [illegible] 4MB	[illegible]
TI [illegible] 4MB	[illegible]
IBM PS [illegible] 4MB	[illegible]
IBM [illegible] 4MB	[illegible]
IBM [illegible] 4MB	[illegible]
IBM [illegible] 1MB	[illegible]
IBM [illegible] 2MB	[illegible]
IBM [illegible] 2MB	[illegible]
IBM [illegible] 4MB	[illegible]
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TOSHIBA [illegible] 4MB	[illegible]
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Zoom 24/96 with Voice: VFDI Internal / VFDX External	$95 / $112
Zoom 14.4 PKTExternal	$225
with Voice	$265

Supra Corporation

SupraFaxModem Internal 24/96 NEW!	$53
Supra 2400 External	$59
SupraFaxModem 144LC Class 1 only External DOS / Windows	$179 / $179
SupraFaxModem V.32 bis, Internal with FaxSoftware DOS/Win	$145 / $145
SupraFaxModem V.32 bis, Ext. alone	$229
with Fax Software DOS	$239
with Fax Software for Win	$239
with Fax Software for Mac	$275

USRobotics

Sportster 14.4 Internal / with Fax	$155 / $175
Sportster 14.4 External / with Fax	$175 / $199

National Semiconductor

Tyln 200 PC Communication Center: fax, modem, voice mail, recorder in a single board $179

REMOVABLE

SyQuest

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555 44MB Internal	$269
5110C 88MB Internal	$389
Mobile Cart 44MB / 88MB	$69/$79
105MB drive only IDE/SCSI	$429/$509

MicroNet Technology, Inc.

For DOS/USA

AT-R45 Int. 44MB Syquest Drive Kit	$465
AT-R90C Int. 88MB Syquest Drive Kit	$615
MR-45 Ext. 44MB Syquest Drive Kit	$589
MR-90C Ext. 88MB Syquest Drive Kit	$735

All Kits include 1 blank tape cartridge. One year warranty. FREE DELIVERY!

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BC 400 400 VA, 2 outlet	$149
BC 500 500 VA, 4 outlet	$179
BC 400LAN 400 VA, 4 outlet, LAN inter	$149
BC 500LAN 500 VA, 4 outlet LAN inter	$189
BC 600LAN 600VA, 4 outlet LAN inter	$245
BC 750LAN 750 VA, 4 outlet LAN inter	$299
BC 900LAN 900 VA, 4 outlet LAN inter	$345
BC 1250LAN 1250 VA, 4 outlet, 2 ms switching LAN interface	$479

Omnipower Line Interactive UPS

OMNI 450LAN 450 VA	$269
OMNI 600LAN 600 VA	$349
OMNI 750LAN 750 VA	$429
OMNI 900LAN 900 VA	$489
OMNI 1250LAN 1250 VA	$629

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Back Ups

250, LAN nodes, 386SX, 286 systems, internet hardware, POS	$99
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1250, multiple systems, longer runtime, telecom minis	$489

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Powerchute Software for Unix	$94
Powerchute Plus - Novell	$69

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SPS300 NEW	$185
SPS450 / 650 - 4 outlets	$196 / $299
SPS850 - 4 outlets	$429

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LI380VA / 480VA - 4 outlets	$399 / $449
LI660VA / 950VA - 4 outlets	$479 / $689
LI1300VA / 1700VA - 6 outlets	$899 / CALL
LI2000VA / 3000VA - 6 outlets	CALL / CALL

HARD DRIVES

Seagate

All Seagate Drives Include Universal Installation Manual, AT Rails & Cable

ST-251-1 MFM	$239
ST-351A / 3120A IDE	$115 / $169
ST-3144A / 3243 IDE	$179 / $215
ST-3283N SCSI	$319
ST-3290A IDE	$249
ST-3390A IDE	$319
ST-3550A IDE FREE DELIVERY	$489
ST-3550N SCSI FREE DELIVERY	$889
ST-3600A IDE FREE DELIVERY	$729
ST-11200N SCSI FREE DELIVERY	$1,119

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SCSI 7245 / 7345S	$279 / $395
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CP30254H / CP30344 IDE	$259 / $335
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Z Two Station Kit	$81
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EtherBasket (12AE-2) FREE DEL	$1,979
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LANtastic AI Ends	$135
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Etherlink II/16 8/16 (3C503-16)	$155
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Etherlink 16 TP 16 Bit (3C507-TP)	$295
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Etherlink III	$129
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Panasonic C1381i .28 DPm 1024 x 768	$299
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CTX

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5468Ni 14 28DP 1024x768, Non-Interlaced	$289
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SONY

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ST-07 IDE Controller Hard Drive Only	$29
ST-06 IDE Controller - HD & Floppy	$39
ST-11R RLL 8 Bit Controller	$51

adaptec

1522 SCSI Direction Kit: 16 Bit Standard SCSI with Floppy Support & Drivers	$135
1522 SCSI Direction PLUS Kit	$189
1542C Single	$195
1542C SCSI Master Kit	$249
1542C SCSI Master PLUS Kit	$305
1742 Single Frame	$345

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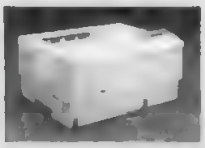

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M97 but with fax)	$1269

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KE10 External	$109

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JT10(40-120)	$275
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includes Colorado Backup for DOS software

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info

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Mustek

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MEDIA VISION

Pro Audio Spectrum 16	$165
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MITUSUMI			
LU005S	Sound Blaster Pro Deluxe	$319	$409
NEC			
CDR 84-1 Int. w/Multispin	Pro Audio Spectrum 16*	$649	$739
CDR 74-1 Ext. w/Multispin	Pro Audio Spectrum 16*	$759	$849
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- US Atlas MPC
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Stealth Pro ISA, 1MB / 2MB	$235/$329
Stealth Pro VLB 1MB / 2MB	$245/$329
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ATI

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ATI Ultra Pro 2 MB	$315
ATI Ultra Pro 2MB VLB - NEW	$349

ORCHID

Fahrenheit VA, 1MB	$205
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ProDesigner IIs, 1MB	$135
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9GXE, 1230 x 1024 NI, SVGA:

LVL 10 1MB	$239
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- MacMillan's Children Dictionary
- Dinosaur Adventure
- Interactive Storytime V.2

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- American Bussiness Phone Book with Yellow Pages
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- RomMaterial

This special is available with and at the time of purchase of any CD ROM drive or upgrade kit.

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MEDIA VISION

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Fusion CD 16 Int / Ext ..... $479 / $479
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MITSUMI

CRMC-LU005S, Internal $185
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CD ROM Drives with Multispin
CDR 84-1 Int / 74-1 Ext ..... $419 / $509
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Int I / Ext ..... CALL
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Multimedia Bundle: Int / Ext ..... CALL

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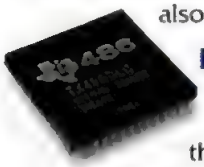

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MOVING?

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New! Alpha FOUR Version 3.0 Is Here!

(Get 5 customizable, ready-to-use applications with New Alpha FOUR Version 3 For Just $19.90)

Presenting a fresh new version of the world's most popular database for non-programmers. New features include full editing access to all databases, real-time and conditional posting – and a whole lot more. The database for anyone is back with a new version. It's great! You've got to get your copy today.

Create My Own Database Applications... Can I Do It? That's what I asked myself when I thought about building my first application. Can I really do it myself? Or should I hire a programmer to do it for me?

At first I backed off and priced out some programmers. Wow! Never mind. I'll try and do it myself. After surveying the numerous products out there I finally found the absolute best tool for creating custom applications – without the complications and time needed for writing code. Alpha FOUR – the database for Non-Programmers like me. New Version 3 gives me 10 times more power, increased speed and it's even easier to use!

Alpha FOUR's Tutorial was magnificent – the best I've ever seen. In a few short hours I was well on my way to building a powerful database solution. I created my first database, complete with a colorful, custom screen and field rules that even capitalize the first letter of each word. It was incredibly easy.

From there I made my first application. Nothing to it. Alpha FOUR let me "paint" my menu, so you know it has lots of colors and 3-D effects. It looks great. Using Alpha FOUR's unique applications outliner, I built custom menus for all my database work. And my application runs directly from the DOS command line.

Alpha FOUR has full relational capabilities too, that means it can link up to 10 databases all at one time, and make it look like they are one big database. That's important because you don't want to enter data more than once. Look at the Invoice screen I made for Cycle City on this page. That's actually 3 separate databases. 1 for the invoice information, 1 for the customer information, and 1 for the parts information. If I didn't use a relational database, all that information would be unnecessarily duplicated. But with Alpha FOUR, I don't have to worry. Know what I like the most about Alpha FOUR? It seems every time I need something, Alpha FOUR is right there with the answer. It's always one step ahead. That's a good program. The kind that's perfect for people like you and me.

Plus, let me tell you about the Alpha FOUR Custom Applications Pack – it's available for just $19.90. The Application Pack includes 5 ready-to-use, customizable applications, Inventory/Invoicing, CD/Video/Book Library, Membership/Fund Raising, Mailing List Management, and Business Contact Management.

I've already used the Invoicing and Inventory application for my business to generate my own invoices and track my inventory. And, each application uses the new, breakthrough features available in Alpha FOUR Version 3. For example, with the new Version 3 scrollable regions feature, I get full editing access to all my databases in a set on-screen at once. And now for the first time, I can see, add, edit, or delete entries in a Child database while the Parent database is on the screen.

Another handy new feature is the real-time and conditional posting. This feature does away with manually-activated batch posting. Any adds, deletes, and changes I make to a field can be automatically posted to fields in matching records in other databases. This means no more "down time" for batch posting operations.

Some of the other Alpha FOUR Version 3 features I used in the Applications Pack included cascading lookup tables, auto advance, color control over forms, and customized menus. What's more, scripts, macros, custom forms and reports are also included in the Applications Pack. They're a great starting point for me. I can use them as is, or modify them to meet my own business requirements.

Create custom menus in seconds

Alpha FOUR's new multi file data entry, combined with multi-record scrollable regions on forms, real-time posting, and cascading look-ups, gives you incredible power and control over your data and your business.

Totally dBASE Compatible. I was delighted to hear Alpha FOUR is totally compatible with dBASE .dbf files. Our mailing list went right into the new application without even having to be converted! And when my Alpha FOUR application grows, it'll import those Lotus 1-2-3 files used over in accounting. In fact, Alpha FOUR can import and export Lotus 1-2-3, Symphony, VisiCalc, PFS, MultiMate, WordPerfect and more.

Great Looking Reports Are An Alpha FOUR Specialty! I love Alpha FOUR's "What You See Is What You Get" report writer – with just a few menu selections, you can create custom screens and printed reports to fit any need: long text fields in multi-line columns with word wrapping. Or format numeric fields to print out as words for the "Pay this amount" line on your blank checks.

Alpha FOUR also contains built-in layout editors to create professional quality (and fully customized) letters, invoices, announcements – virtually any document.

WHY ALPHA FOUR?

Version 3 has all this. • Full Mouse Support • Multi-File Data Entry • Scrollable Regions • Real-Time and Conditional Posting • Referential Integrity • Cascading and Conditional Lookups • Enhanced Scripting • Fully Customizable View and Browse • Menus • Color Control on Forms •

..so you can do all this: • Create and Maintain Mail/Customer Lists • Automate Inventory/Invoicing/Payroll • Create Personnel/Sales Systems • Track Mailings with Precision • Create a Time Billing System • Create a Parts Catalog • Create Custom Sales/Prospecting Systems • Create Personnel Management Systems • Plus Much More!

ASK ABOUT THE ALPHA FOUR SERVER UNIT
You Get TWO Extra Network LAN Packs Inside
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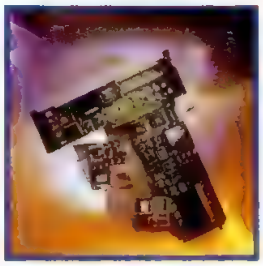

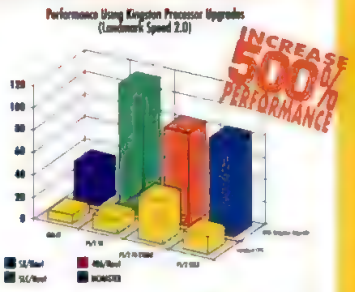

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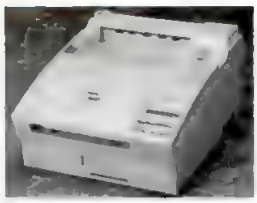

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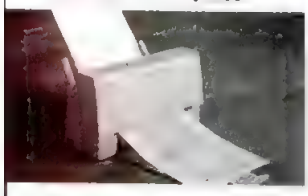

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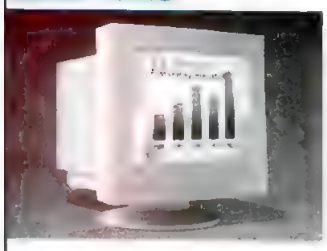

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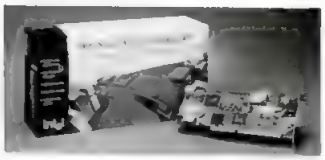

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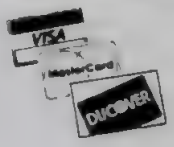

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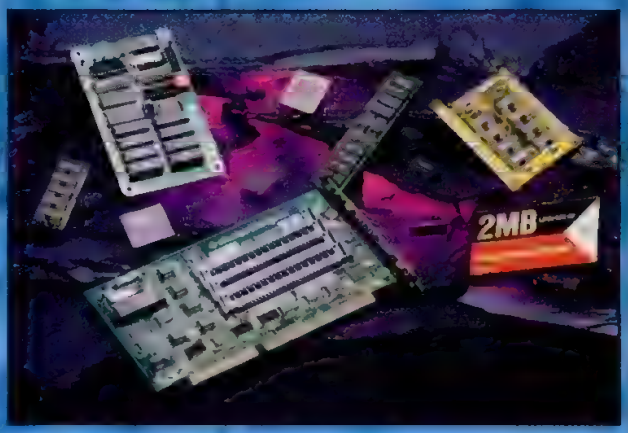

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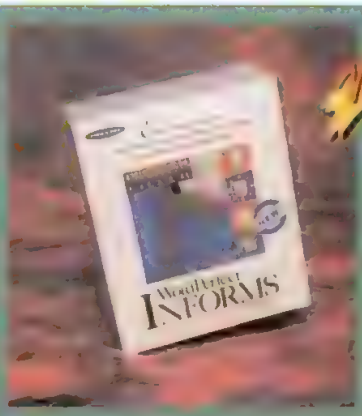

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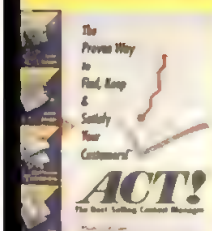

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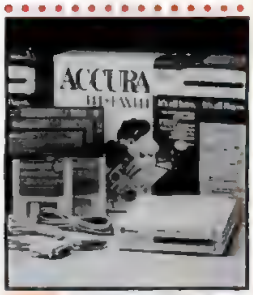

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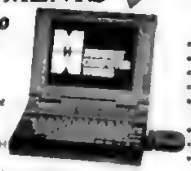

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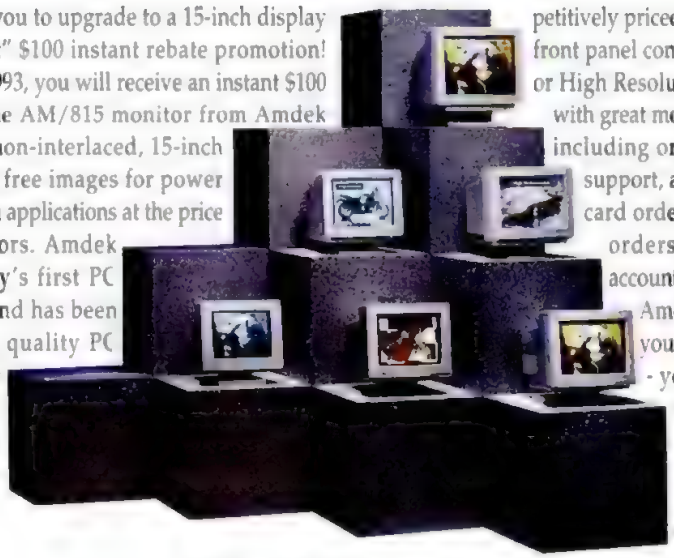

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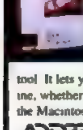

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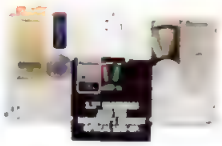

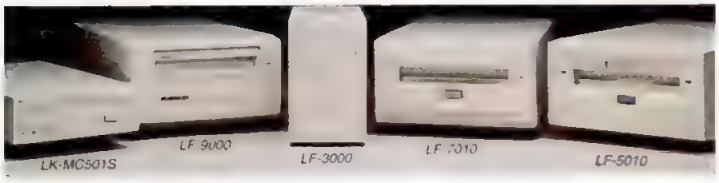

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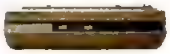

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T1000/T2000SX	2Meg	PC18-PA8317U	84 00
T2000SX/T1000LE	4Meg	PC-PA8314U	159.00
T2000SX/T1000LE	8Meg	PC14-PA8315U	279.00
T2000SXE 2200SX/T1800, 1850, C	2Meg	PC-PA2000U	84.00
T2000SXE 2200SX/T1800, 1850, C	4Meg	PC-PA2001U	159.00
T2000SXE/2200SX/T1800, 1850, C	8Meg	PC-PA2002U	279.00
T4400SX, SXC T6400	4Meg	PC-PA2004U	164.00
T4400SX, SXC T6400	8Meg	PC-PA2005U	299.00
T4400SX SXC T6400	16Meg	PC-PA2010U	599 00
T4400SX SXC,T6400	32Meg	N/A	2599.00
T4500, T4500C, T4600, T1900, T1900C (3.3 v)	4Meg	PC-PA2012U	239 00
T4500, T4500C, T4600, T1900, T1900C (3.3 v)	8Meg	PC-PA2013U	419 00
T4500 T4500C T4600 T1900, T1900C (3.3 v)	16Meg	PC-PA2014U	1299 00
T4500, T4500C, T4600, T1900, T1900C (3.3 v)	32Meg		3299 00
T3300SL	4Meg	PC-PA2007U	169.00
T3300SL	6Meg	PC-PA2008U	229 00
T3300SL	8Meg	N/A	369 00
T3300SL	16Meg	PC-PA2009U	749 00
T1200XE	2Meg	PC13-PA8306	85.00
T1600	2Meg	PC8-PA8302U	85.00
T3100	2Meg	PC3-PA7135E	129 00
T3100e	2Meg	PC9-PA8340U	85 00
T3100SX	2Meg	PC15-PA8308U	85.00
T3100SX	4Meg	PC15-PA8310U	164.00
T3200	3Meg	PC6-PA7137U	159.00
T3200SX	2Meg	PC12-PA8307U	85.00
T3200SX	4Meg	PC12-PA8909	164.00
T3200SXC	2Meg	PC19-PA8318U	84.00
T3200SXC	4Meg	PC19-PA8319U	164.00
T5100	2Meg	PC7-PA8301U	89 00
T5200/T8500	2Meg	PC10-PA8304U	89 00
T5200/T8500	8Meg	PC10-PA8313U	299.00

NOTEBOOK, LAPTOP MEMORY

MODEL	AMT. UPGRADED	MANU. PART #	PRICE
A&R Venture	4Meg	12407980	229 00
AST Notebook Prem Exec 386SX/20/25/25L	4Meg	500814-003	149.00
AST Power Exec 3/25C, 425EL	4Meg		179 00
AST Power Exec 425SL	4Meg		249 00
AST Power Exec 425SL	16Meg		1319 00
AT&T Safari NSX/20	4Meg	PEC 37651	189 00
Bondwell B310, Plus	1Meg	23050-09100	109 00
Bondwell B310V, SX	1Meg		109 00
Bondwell B310V, SX	4Meg		219 00
Epson NB3	4Meg	A808511	179 00
Epson NB/SL 20,25,25C	2Meg	A808771	129 00
	4Meg	A808781	219 00
	8Meg		479 00
Everex Tempo LX, LX20	2Meg	PCA 00053-0001	89 00
Everex Tempo Carrier	2Meg	PWA 0884-A-J000	119 00
Goldstar GS520 386SX/16	4Meg	S386-4M	239 00
Leading Edge D/LT 386SX	1Meg		109 00
Magnavox Metalis	1Meg, 4Meg	286, 386SX	99.00,189.00
NCR 3170	4Meg	3123-K104-V001	239 00
NCR 3170	8Meg		519 00
NCR 3170	16Meg	3123-K116-V001	925.00
NEC Prospeed 286, 386SX-16	1Meg	PC21-21	105 00
NEC Prospeed 286, 386SX-16	4Meg	PC21-22	179 00
NEC Prospeed 386	2Meg	PC31-21	129 00
NEC Prospeed 386	8Meg	PC31-22	359.00
NEC Prospeed 386SX-20	1Meg	PC43-21	109.00
NEC Prospeed 386SX-20	4Meg	PC43-22	199 00
NEC Ultralite IIx/20, 20P, 25C	2Meg	PC47-21	119 00
NEC Ultralite IIX/SL/25C	4Meg	PC47-22	219.00
NEC Ultralite SL/20, 20P	6Meg	PC49-21	289 00
NEC Ultralite IIx/25C	8Meg	PC47-23	349.00
NEC Ultralite Versa	4 Meg/8Meg/16Meg		229/429/1389
Packard Bell 386SX, 286	1Meg, 4Meg	286, 386SX	89.00,189.00
Panasonic CF170, CF270, CF370	1Meg	CF-BA165	54.00
Sanyo 17/18 NB	2Meg	MBC-NBMEM2	89 00
Sharp 6781, 6881, 6785	2Meg/4Meg		109.00/199 00
Sharp PC-6220	1Meg	CE 621B	85 00
Tandon, PC Brand, Datavorld	2Meg, 8Meg	NB386SX-20	89.00, 499 00
TI Travelmate 2000	1Meg	2568034-0001	85 00
TI Travelmate 3000	2Meg	2566996-1	79 00
TI 4000	4Meg, 16Meg		199.00, 1599.00
Twinhead, Altima, Compudyne Tandy 4860, 486SX, DX	4Meg/16Meg		199.00/999 00
Zeos 386SX Notebook	2Meg		89 00
Zenith Master Sport 386SX	2Meg	ZA-300-1	99 00
Zenith Master Sport SL, SLE	2Meg	ZA-4-4	89.00
Zenith Super Sport 286, 286E	1Meg	ZA-180-66	89 00
286E, SX	2Meg	ZA-180-64	109 00
SX Alpha	2Meg	ZA-180-66	109.00
SX Beta	2Meg	ZA-180-67	109 00
Zenith Z-Note 325L, LC	2Meg/8Meg	ZA3250-4/-5	129.00/369.00

LASER PRINTER MEMORY UPGRADES

AMOUNT UPGRADED	OK Bd	256k	1	2	3	3.5	4	5	8	9	16	32
Canon LBP4, 4Lite, 4plus	–	–	119	169	–	–	–	–	–	–	–	–
Canon LBP-4SX	–	–	89	249	–	–	–	–	–	–	–	–
Compaq Pagemarq	–	–	69	99	–	–	169	–	–	299	–	–
Epson 6000, Action Laser	–	–	–	115	–	–	179	–	–	–	–	–
Epson Action Laser II	–	–	99	–	169	–	–	249	–	–	–	–
Epson 8000	–	–	99	–	169	–	–	249	–	–	–	–
Epson 1000	–	–	–	72	–	–	144	–	216	–	–	–
HP 2, 2D, 3, 3D, 3P, 2P 2P+	–	–	–	89	–	–	159	–	–	–	–	–
HP 4, 4M, 4SI, 4SIMX	–	–	–	80	–	–	149	–	–	309	–	–
HP 4L	–	–	69	–	–	–	–	–	–	–	–	–
HP 3SI	–	–	49	–	–	–	139	–	–	309	–	–
HP 4SI	–	–	–	80	–	–	149	–	–	309	–	–
HP Deskjet 500, 500C, 550	–	55	–	–	–	–	–	–	–	–	–	–
HP Deskjet 1200C, 1200C/P	–	–	–	129	–	–	209	–	–	399	–	–
HP Paintjet XL300	109	–	–	–	–	–	268	–	–	–	745	–
IBM Laser 4019, 4019E	–	–	–	–	–	144	–	–	–	–	–	–
IBM Laser 4029	–	–	–	–	–	–	139	–	–	–	–	–
IBM Laser 4039	–	–	–	–	–	–	169	–	–	319	–	–
NEC 90, 290	–	–	–	109	–	–	–	–	–	–	–	–
NEC 95	–	–	–	99	–	–	–	–	–	–	–	–
Oki 400	–	–	–	94	–	–	–	–	–	–	–	–
Oki 830, 840	–	–	–	109	–	–	–	–	–	–	–	–
Packard Bell PB 9500	–	–	–	115	–	–	179	–	–	–	–	–
Panasonic 4420/4450i	–	–	–	119	–	–	189	–	–	–	–	–
Panasonic 4410/4430	–	–	–	109	–	–	169	–	–	–	–	–
Panasonic 4450	–	–	99	–	–	–	–	–	–	–	–	–
Star LS04	–	–	109	159	–	–	249	–	–	–	–	–
TI XL/PS17/PS35	–	–	49	–	–	–	–	–	–	–	–	–

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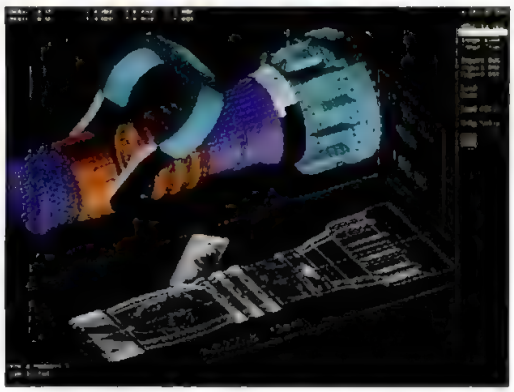

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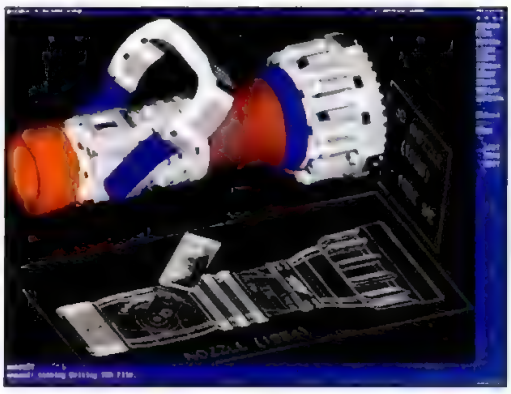

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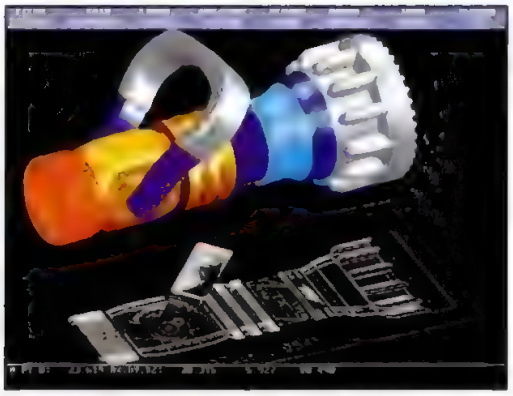

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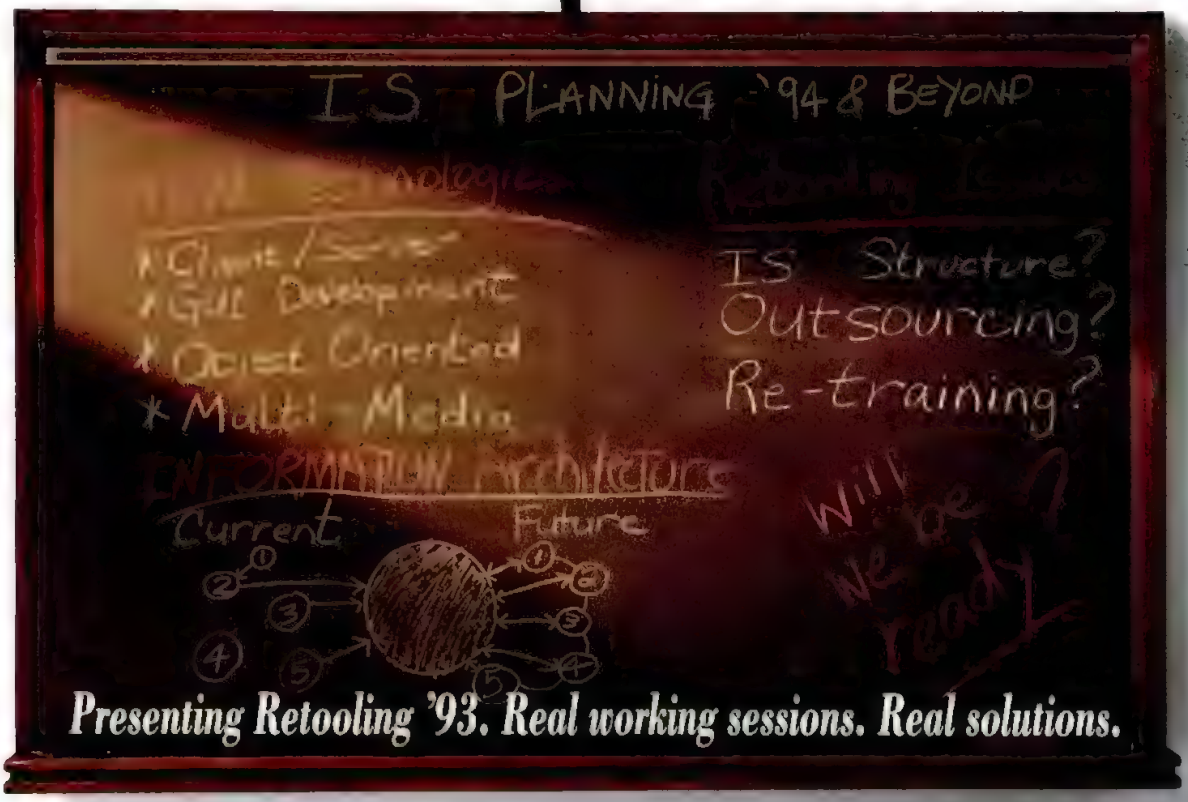

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- Achieving Object Nirvana — Case studies of successful migration to object technology
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- How Visual Basic can become the glue that binds together custom solutions
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- Ending the Network Administration Nightmare — Products and techniques that really work
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- Winning Training and Support Strategies — How to slash the high cost of support
- Building Mail-enabled Applications — Using the mail engine for business solutions
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Paint Shop Pro	PSPRO.ZIP	Windows screen capture, file conversion and image-editing system — trim, resample, filter, gamma correction and more.	PBSAPPS LIB 8
Winvelope	WINVEL.ZIP	Envelope printing utility for Windows. Also prints postal bar codes.	PBSAPPS LIB 4
Castle of the Winds	$CASTL.ZIP	Fantasy game for Windows based on Norse mythology. 100 unique monsters oppose your quest.	PDS ARCADE LIB 4
MONSTER BASH	BASH.ZIP	Brave an enchanted world of zombies, skeletons, vultures, and walking hands! May not be suitable for young children.	PBS ARCADE LIB 3
WINPAK #1 & #2	**WNPAK1.ZIP WNPAK2.ZIP**	**4 animated screen savers, 2 True Type fonts and over 100 icons for Windows 3.1. Listed in *PC Computing* "BEST BETS" section (May 1993)!**	**PBSAPPS LIB 8**
Icondos	ICNDOS.ZIP	Graphical DOS application launcher with clock, calendar, screen saver, over 100 icons and 20 wallpapers.	PBSAPPS LIB 6
After Dark Screen Savers	ADMODS.ZIP	A collection of screen-saver modules, including the world-famous "Bungee Jumping Cows." Requires "After Dark."	PBSAPPS LIB 8
C Tutor	CTUTOR.ZIP	Interactive C tutorial with step-by-step C programming coverage.	PBS ARCADE LIB 10
SIMSTAT	SIMST1.ZIP SIMST2.ZIP	Powerful statistics program. Includes multiple regression, time series analysis, nonparametric analyses, bootstrap simulation, hi-res graphs, etc. Reads 1-2-3, dBase, ASCII, SPSS/PC+ files.	PBSAPPS LIB 9

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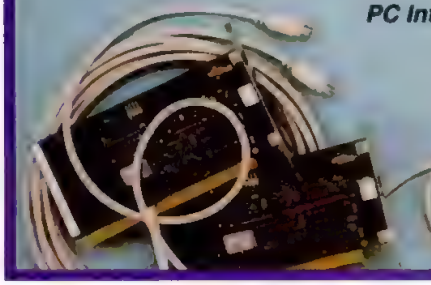

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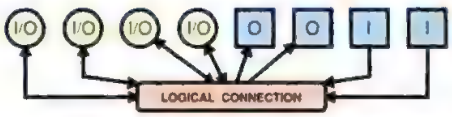

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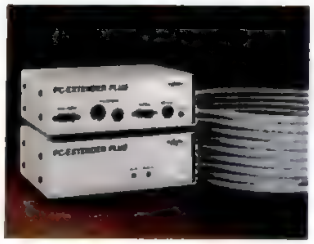

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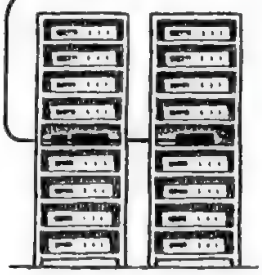

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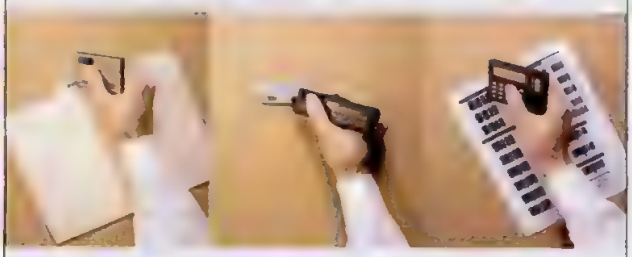

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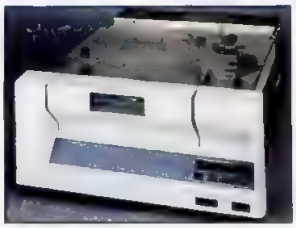

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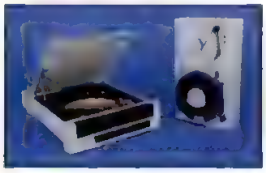

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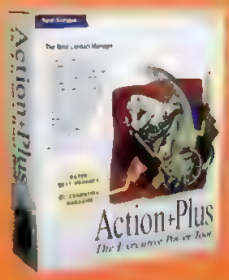

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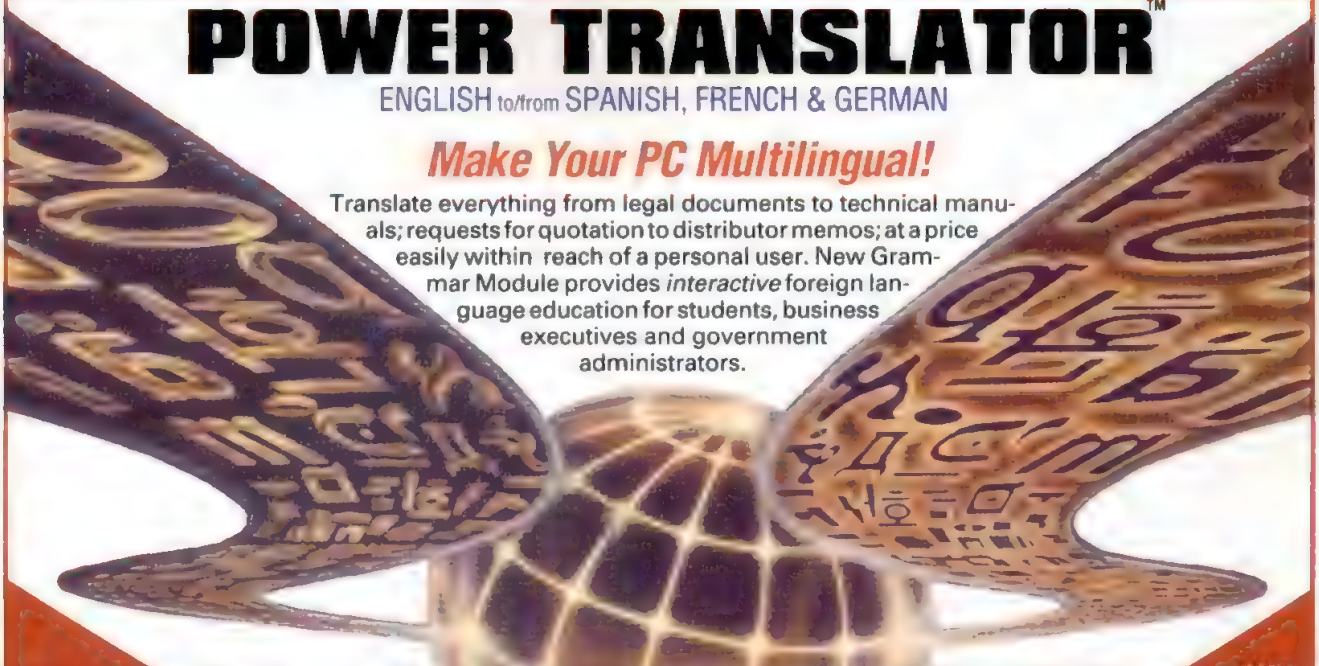

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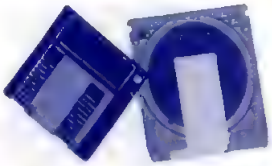

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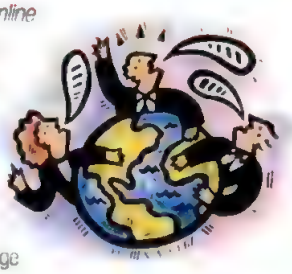

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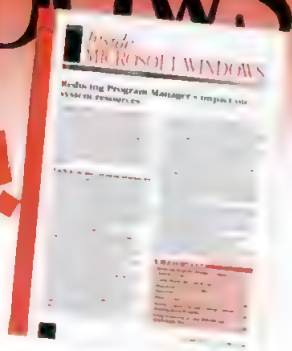

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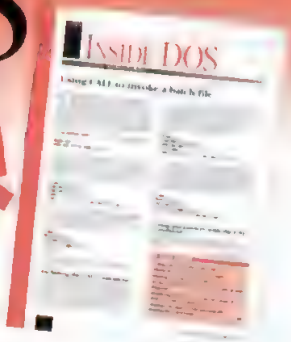

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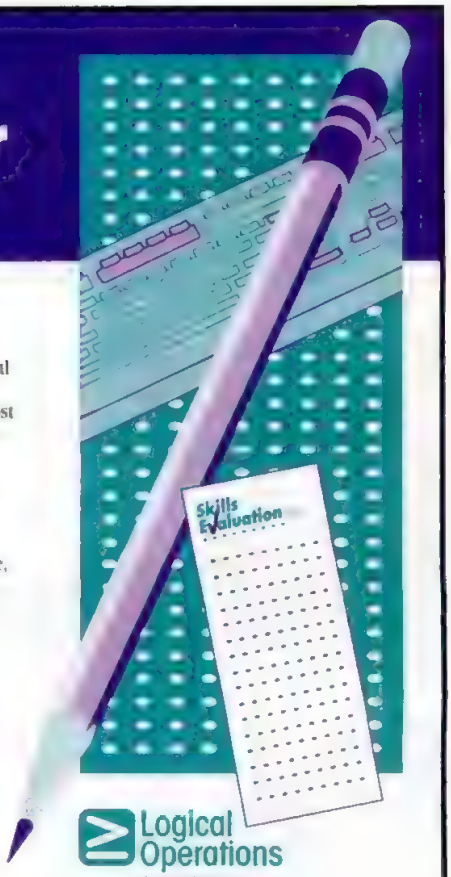

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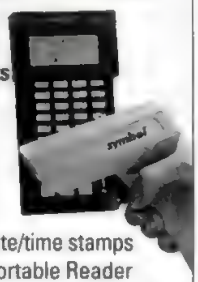

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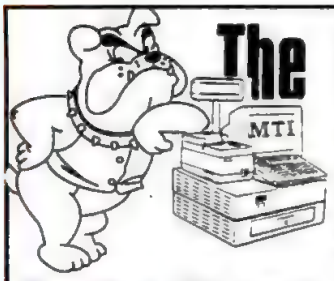

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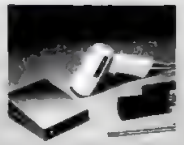

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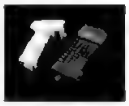

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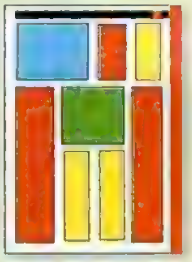

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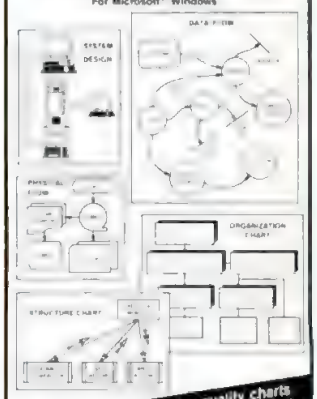

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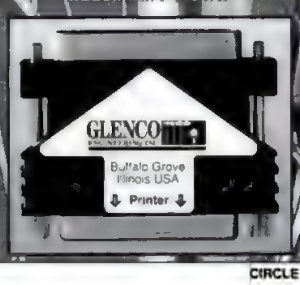

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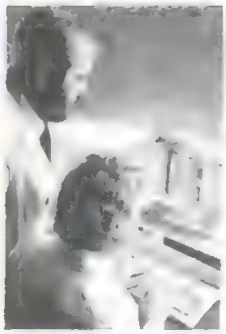

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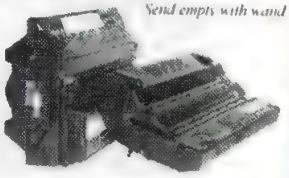

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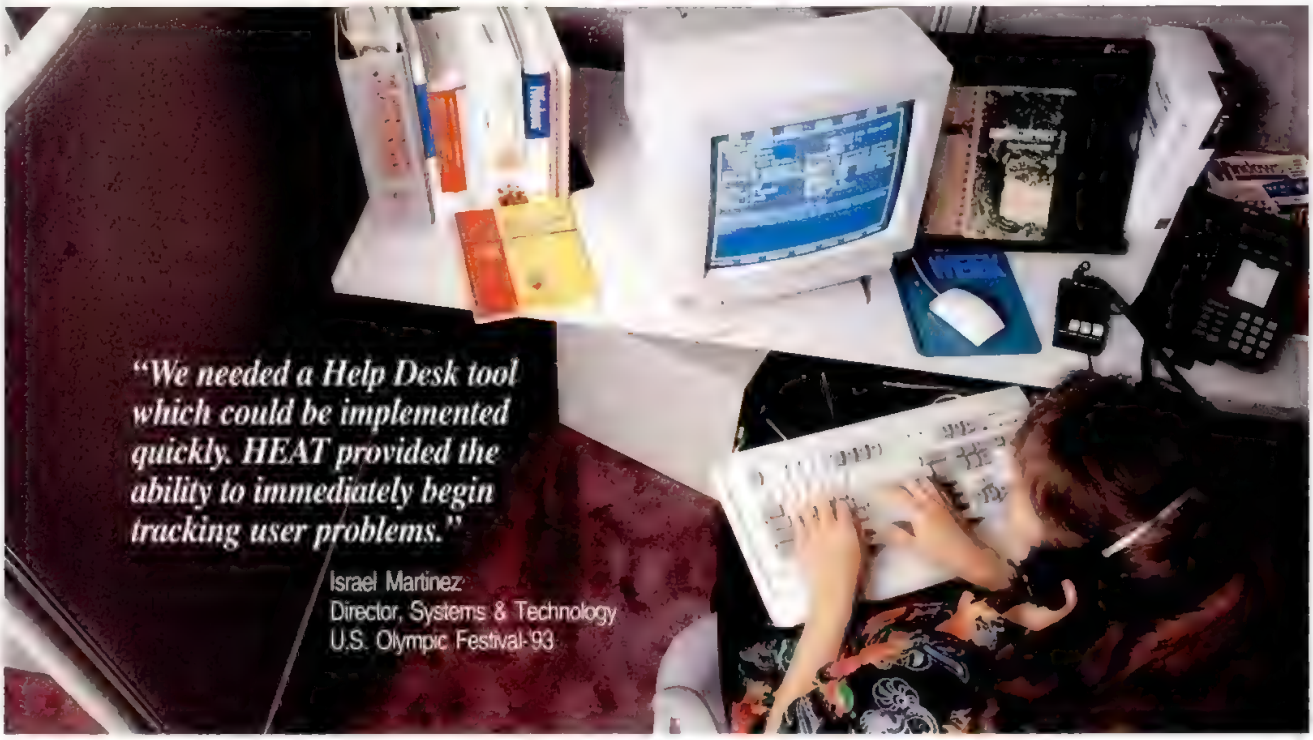

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PC MAGAZINE

Coming Up

Family Values

With such an abundance of choices among value lines, more traditional lines of PCs, and hybrids of all shapes and sizes, buying a computer now can often become a lesson in confusion and frustration. *PC Magazine* puts ten different vendors' lines to the test to find out what you get—and what you give up—by choosing the lower price tag.

New Dimensions in Spreadsheets

Spreadsheets have become much more than just rows and columns. They have been extended, transformed, and redefined in ways that allow users to move beyond the traditional approaches to working with numbers that are found in yesterday's spreadsheets. *PC Magazine* looks at some spreadsheet-like products that use everything from fuzzy logic to flowcharts to multiple data dimensions for data modeling, analysis, and reporting.

Big Hard Disks

If you need hefty storage for your file server or power desktop machine, now is definitely the time to buy. Prices for SLEDs (Single Large Expensive Disks) are down to near $1 per megabyte and performance is better than ever. Connect two to a single controller and you can have a low-cost RAID Level 1 subsystem that provides true data integrity. We put nine 1GB to 1.6GB Fast SCSI-2 drives through our rigorous benchmark tests.

BASIC Power

Today's BASIC language implementations rival Pascal and even C when it comes to powerful syntax, clean structure, and state-of-the-art executable code. New visual tools let you write Windows programs in BASIC without the complexity of writing directly to the Windows API. *PC Magazine* tests eight professional BASIC development systems for DOS and Windows, picking a winner in each class.

LAN Backup Goes Automatic

LAN backup used to be a matter of copying copious amounts of data to a tape drive where bleary-eyed administrators would sit changing cartridges. That's changing. Automation is the key, with human involvement reduced in favor of tape autoloaders, which automatically migrate files and generate reports that can even be sent via fax or e-mail. *PC Magazine* looks at the present—and future—of LAN backup.

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BACK-TO-SCHOOL

PC-Based Study Aids Start the School Year Right

BY PETER SCISCO

Battles over curriculum, property taxes, and cultural diversity make the headlines, but, under it all, success in school and after depends on mastering math, reading, research, and critical thinking skills. For college-bound kids, the ability to translate those skills into a high SAT score is critical as well.

PC software can play a role at every stage in the process. Here's a look at three programs that deal with critical areas, an SAT test-preparation program, and a computerized path through the college-application jungle.

BRODERBUND SOFTWARE INC.

PC USA

These days, kids can name the professional sports franchise for two dozen cities across the country; but it's likely they can't find half those cities on a map. A program like PC USA can make a difference. Reissued after Broderbund Software acquired PC Globe, the program's developer, PC USA combines clearly detailed information, colorful maps, and the engaging technology of a personal computer with an electronic atlas of the United States. Students at 10 and up will find it useful for reference and homework.

Of course, the basis for information in PC USA is a map of the United States. Students can segment the map by historic (Louisiana Purchase, the Confederacy of the Civil War) or political groupings (Republican or Democratic governors and senators or the results of the 1992 presidential election); alternately, they can zoom in on nine specific regions (New England, South Atlantic, Pacific).

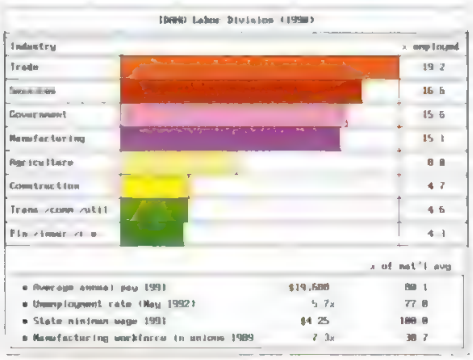
Making the most of the program's point-and-click interface, students can select specific states with the mouse (the program also accepts keyboard commands through a series of menus). Each state map can display major cities and geographical features, although those features don't appear on the full U.S. map.

PC USA is a vault of statistical data drawn mostly from the U.S. Bureau of the Census, as well as from policy think tanks, research centers, and reference book publishers. Broderbund has added value to the original product by adding more than 300 new data categories, many of which were compiled as late as December, 1992.

Statistical information is presented in tables and in bar graphs. After selecting regions or states, the student can select specific categories of data for comparison. Categories range from agricultural production to highway fatalities and dip into particular areas, such as Teen Violent Deaths, Low Birth Weights, Personal Income—hundreds of pieces of data one can compare by region, state, or nationwide.

All of the data is easy to get to and can be exported as an ASCII text file or, with maps and graphs, as a .PCX graphic file. There is also an option to create a caption, and to print information.

Using PC USA as a reference is a quick way to research a project. But care should be exercised when using the data in reports. The graphs and maps created for use in other applications do not automatically create citations for the source material. Some of the information may be incorrect or out of date. An example is the state sales tax rate for North Carolina (listed at 4 percent, the figure is actually 6 percent). The program confers statehood on Puerto Rico and the District of Columbia without benefit of congressional approval.



NEW DATA: PC USA's maps remain the same, but more than 300 data catagories have been added.

Despite these shortcomings (you'll find similar faults in almost any atlas), PC USA is a valuable tool for making comparisons that can spark an interesting and engaging school assignment. And for Mom and Dad, the program's area code and zip code directories are a valuable asset.

PC USA, Version 3.0, *$49.95.* Requires: *512K RAM, DOS 2.0 or higher, 1.2MB hard disk space. Broderbund Software Inc., 500 Redwood Blvd., Novato, CA 94948-6121; 800-521-6263, 415-382-4400; fax, 415-382-4582.*

Circle 458 on reader service card

BUREAU DEVELOPMENT INC.

Monarch Notes

Cramming for finals. Getting to the end of the semester's reading list in Late Renaissance Lit. Catching up on school assignments, after spending most of the week devouring a Stephen King book. What would a student do without Monarch Notes? Like education itself, this venerated and vilified institution has stepped into the computer age with a series of programs placing the study guides as close as a computer's hard disk.

Each one of the five volumes of Monarch Notes on Floppy contains the full text of several guides, traditionally published in booklet form. *Volume 1: The Lit-*

erary Tradition includes 60 study guides; Volume 2 contains 37 guides to 19th-century literature; Volumes 3 and 4 cover 75 20th-century works. *Volume 5: Shakespeare* is a little different. It contains not only 25 study guides on the playwright's work but also offers the full text of all his plays and sonnets.

There is one catch. All these volumes require huge amounts of hard disk space: about 19MB apiece. Fortunately, a CD-ROM version with the study guides of all five volumes is available, but not Shakespeare's plays and sonnets.

Like the traditional study guides, the computer versions contain summaries of literary works, critical analysis, bibliographies, and sample exam questions. Any student would benefit from the thoughtful essay responses designed to accompany study questions, integrating historical and critical analysis to broaden a student's understanding.

TEXT-BASED INTERFACE

Overall, the program's design is straightforward, if not forward-thinking. The entire program, as one might expect, is text based, with no button bars, scroll arrows, or other suggestions of a graphical interface. A blue menu bar at the top of the screen offers options for searching, browsing, or contents. If more than one volume of Monarch Notes on Floppy has been installed, the titles are listed under the Database menu.

The value of the computer version becomes evident as students begin to search for text according to ideas they might want to explore in a paper. Using Boolean search routines, students can search for words, phrases, or author names. Wildcard characters (* and ?) can be used in searches; proximity searches are also available.

The Browse option lists keywords, authors, subjects, and titles alphabetically. You can move through the list with a cursor key or type a word for a specific point in the list. The Contents menu is an alphabetical list of the disk's contents, including all of the study guides. Selecting one of the entries from the Contents list brings up a further menu with a more specific contents list, including the Study Guide, which includes the critical commentary.

Despite these wonderful search and index capabilities, the program fails to exploit the possibility of hypertext links within the text itself. For example, reading the critical commentary for Alexander Pope's mock epic poem *The Rape of the Lock*, a student may come across the term Augustan to describe the school of poetry to which the work is assigned. A more robust design would provide instant and easy access to a glossary.

BOOLEAN: Software adds database functionality to the venerated and vilified Monarch Notes.

Commentary, the guides' original text, and summaries can be printed, or they can be copied to a text file. Parents and teachers will therefore have to spot students passing off the erudite commentary as their own work.

Monarch Notes on Floppy cannot replace the leadership of an enthusiastic teacher or the insight born of a lively class discussion. But, used properly, they are an excellent supplement to classroom study.

Monarch Notes on Floppy: Volume 1, 2, 3, 4, *$49.95 each;* **Volume 5, Shakespeare,** *$59.95; CD-ROM version, $99.95.* Requires: *640K RAM, DOS 3.1 or higher, 19MB hard disk space per volume. Bureau Development Inc., 141 New Road, Parsippany, NJ 07054; 201-808-2700; fax, 201-808-2676.*

Circle 459 on reader service card

CD-ROM Pick Hit: *Dinosaurs*

JUMPING ON THE JURASSIC BANDWAGON, *Microsoft takes you on a prehistoric safari with its latest multimedia CD-ROM title, Microsoft Dinosaurs. Replete with detailed drawings, hot-linked text, and fascinating if mildly graphic animated dino videos, Dinosaurs is instantly usable and a visual delight. (Microsoft Corp.; 800-426-9400.)*

CLIFFS STUDYWARE

Cliffs StudyWare for the SAT

Preparing for the Scholastic Aptitude Test is an anxious time for high-school students. Some turn to expensive personal tutors and test-prep classes; others buy paperback study guides and hope for the best. Cliffs StudyWare for the SAT marries test-preparation techniques with the computer's ability to analyze data, creating an interactive guide that tracks student progress and suggests learning strategies.

The program offers two exams, which can be taken in tutorial or test mode, and which can be analyzed to find weak areas and to suggest further study. A companion SAT Preparation Guide explains effective test-taking strategies and answers general questions about the test.

For best results, a student

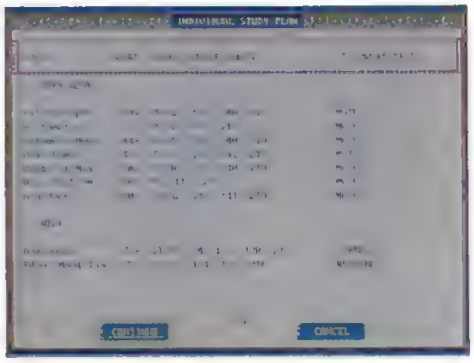
will want to read the introductory material in the Preparation Guide and then take StudyWare Test 1 in Test mode. Though a time limit is imposed during an actual SAT, and quick response is of the essence, students can safely ignore an on-screen clock during the initial test. It's helpful for a student to take note of the elapsed time for each exam section as a mark against which to improve.

Unlike a personal tutor, the program can generate results and reports instantly and provide an immediate breakdown of the types of questions missed—even specific types of reading comprehension questions, for example. Using the Topic Breakdown to isolate weak areas, students can quickly identify parts of the exam that may cause trouble; they can then work to improve performance.

TWO TEST MODES

Both tests can be taken in either Test or Tutor mode. Test mode is designed to simulate an actual test-taking experience, though lacking some conditions. The test taker, for example, must click on a box to choose an answer instead of blackening a small oval, as a real exam requires. Also, reading passages appear on a separate screen from questions, as do diagrams and problems in the math section. On the SAT, questions, answers, and relevant information are shown in close proximity. Within the program, a student must read a question, examine possible answers, and toggle from screen to screen for relevant passages or diagrams.

The Tutor mode provides instant feedback for the student's selections. The program provides a brief explanation of why a wrong answer is incorrect. If the student chooses incorrectly a second time, the program highlights the correct answer. The student can then select the correct answer for an explanation. Specific drills in problem areas are also helpful.



INSTANT ANALYSIS: Using Cliffs StudyWare for the SAT, students can quickly find their testing weaknesses.

Overall, Cliffs StudyWare for the SAT combines computer power and time-proven test strategies into a sensible and worthwhile program. Students who find the paperback exam books unattractive (and therefore may not use them effectively), or who cannot afford tutoring, will welcome this option.

Cliffs StudyWare for the SAT, *$49.95*
Requires: *256K RAM, DOS 2.11 or later. Cliffs StudyWare, P.O. Box 80728, Lincoln, NE 68501-0728; 800-228-4078, 402-423-5050; fax, 402-423-9254.*
Circle 460 on reader service card

DAVIDSON & ASSOCIATES INC.

What's My Angle?

Ask a roomful of people to raise their hands if they're illiterate, and they'll stare at you as if you were insane. Ask the same room to raise their hands if they're poor in math, and they'll chuckle happily as they wave.

No longer is fear of math acceptable for men or women. With What's My Angle?, from Davidson & Associates, one basic high-school subject—geometry—becomes more approachable. What's My Angle? proposes to teach an understanding of geometry terminology and concepts, to teach how to formulate a proof, and to reinforce critical thinking and problem-solving skills with real-world examples. The program entertains students enough to keep their attention, yet it pinpoints their weaknesses and tracks their progress.

What's My Angle? is divided into five activities, which correspond with, and, in some cases, go beyond, typical high-school-classroom activities. GeoBoard is a pegboard that allows students to experiment with different shapes by anchoring points and then

CollegeLink Eases the Application Process

After the finals, after the SATs, aspiring college students face the daunting prospect of applying for admission.

CollegeLink cannot help with grades or with financial aid, but it can help organize the application process. Not so much a software program as a computer-based service organization, CollegeLink supplies clients with a disk containing a general application that need only be filled out once. The company forwards the information to the schools of the applicants' choice.

Completing a CollegeLink application is as easy as filling out an on-screen form. A built-in word processor can be used for sending a personalized note to the school's admissions office. If the student is working with the high school guidance office, that office can use disks supplied by CollegeLink to make its own reports and to submit transcripts.

Colleges receive a printed application, along with a copy of the information on-disk. Besides the standard student information and records, the CollegeLink software has a built-in editor, so that the applicant can compose an essay of approximately 1,500 words in length. The word processor is quite basic (really not much more than a text editor), but it will do for students who do not own a word processor. CollegeLink also imports ASCII-format files.

Today, more than 400 colleges and universities accept CollegeLink applications.

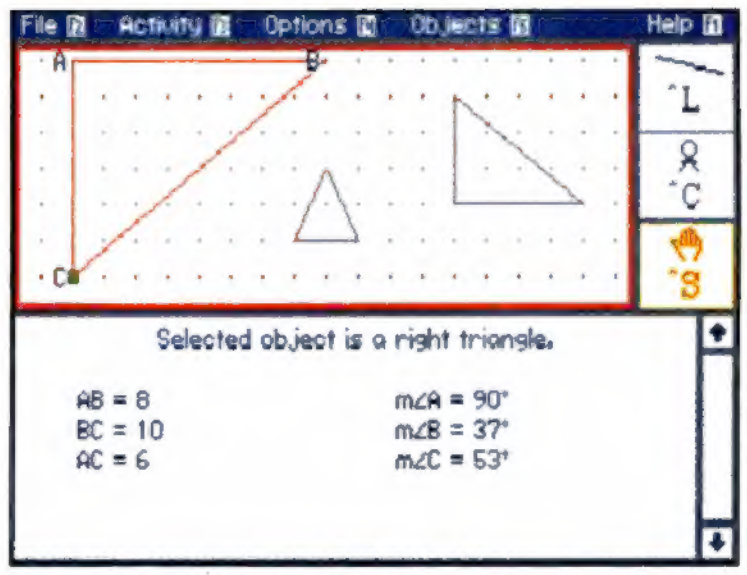
CollegeLink, *$34.95 (up to eight applications, additional ones costing $5 each).* Requires: *512K RAM, DOS 2.2 or higher. The Enrollment Collaborative Inc., 200 Baker Ave., Concord, MA 01742; 800-394-0404, 508-287-0200; fax, 508-287-0000.*
Circle 461 on reader service card

drawing lines between the points. GeoBoard tools can be used to draw angles, triangles, and other straight-line shapes, as well as circles. The interactive selection tool provides students with information about the objects they draw and helps build the vocabulary a student needs to understand geometry. This is an excellent, nonthreatening, exploratory introduction to geometry concepts such as angles and vertices.

GeoLife, a second activity, places students in hypothetical situations with problems that can be solved through the use of geometry. Problems are drawn from various sources: farming, carpentry, construction, space. If a student is puzzled by how to solve a problem, he or she can get a tip; however, the program does not explain correct answers—a feature that would help underscore the lesson. GeoLife has two levels and nine topics.

GeoGolf is an arcade-style miniature golf game designed to help students visualize angles. Up to four players take turns propelling a ball at an angle necessary for putting the ball into the hole. The game is quite fun, making a lighthearted introduction to angles and degrees.

On a more serious note, GeoProof and GeoConclusion reinforce problem-solving skills. GeoProof gives a student a mixed-up proof, which must be reordered in logical sequence. GeoConclusion presents a diagram, a few given facts, and a conclusion. The object is to support the conclusion with theorems. Both activities draw on advanced geometry skills acquired by the student in class.



THE RIGHT ANGLE: What's My Angle teaches geometry, using pegboards, proofs, and real-world problems.

The glossary is one of the best features in What's My Angle? This quick reference helps students become familiar and comfortable with such terms as "congruent," "collinear," and "vertex," and with symbols that they are likely to encounter in problems.

Through all five of its activities, What's My Angle? maintains a good balance between education and entertainment. The gamelike elements do not overshadow the solid educational content. Instead, the entertainment engages the student and presents the subject matter in an inviting manner. □

What's My Angle?, *$49.95.* Requires: *512K RAM, DOS 2.11 or higher. Davidson & Associates Inc., 19840 Pioneer Ave., Torrance, CA 90503; 800-556-6141, 310-793-0600; fax, 310-793-0601.*

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DON'T GIVE MONEY TO STRANGERS.

Before you give to a heart organization, make sure it's one you trust: The American Heart Association. Since 1924 we've sponsored lifesaving education programs and funded $900 million in research. Others may copy us, but they can't hold a candle to our heart and torch. To learn more, contact the American Heart Association, 7320 Greenville Ave., Box 20, Dallas, TX 75231.

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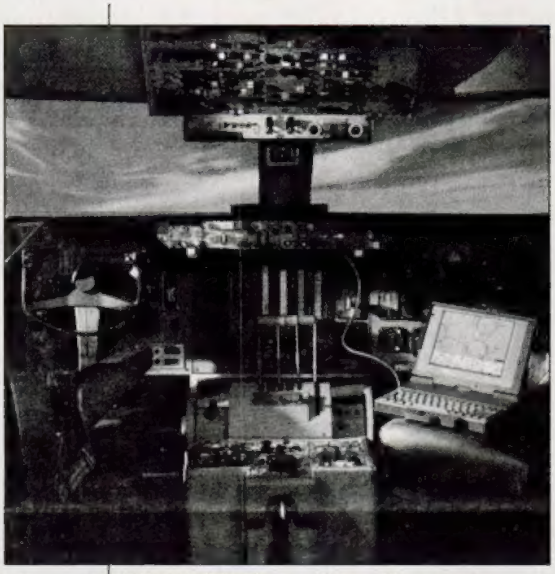
Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Don Willmott



We'd Rather See George Kennedy Sitting There

This AST ad says that the PowerExec notebook is powerful enough to pilot a 747. Can you imagine the conversation?
Pilot: "So, uh, did you give that thing a full battery charge?"
Copilot: "Yeah, no problem. It oughta last eight, nine hours. Let's go take a nap in First Class."

Want Ads From The Starship Enterprise Newsletter

"Sr. Database Analyst: Ideal for a strong senior IDMS DataBase Analyst with a minimum of 7 years experience, who has expanded or wants to expand into distributed SQL. Candidate must demonstrate the ability to function in alien technical environments."

I don't know where my clavicle is, but I do know how to spell it.

Amazing Facts

"Windows frees people from having to type in arcane commands on a keyboard, allowing users instead to respond to easy-to-understand symbols on the screen—like a waste basket for discarding an unwanted file."—*THE NEW YORK TIMES*

This Is Why You Need a CD-ROM

InterOptica's Astonishing Asia CD-ROM features scenes of Thai transvestites, roast dog barbecues, and this talented Chinese snake performer coaxing two live snakes in through his nose and out his mouth. (415-788-8788)

GROANERS

Q. What do you get when you cross Lee Iacocca with Dracula?
A. AUTOEXEC.BAT

If your entry is used, we'll send you $50 and a *PC Magazine* T-shirt. Send your entries to: Abort, Retry, Fail?, PC Magazine, One Park Ave., New York, NY 10016. Winners this issue: Dale Donchin, Gregory Manov, Mr. McCartney, Richard Spitz.

THE GATEWAY TO THE HOTTEST PC TECHNOLOGY ISN'T GATEWAY.

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PCs DESIGNED FOR THE HIGH PERFORMANCE USER.

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ON PLANET EART

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The Viper board is available as an upgrade from Gateway, but the Dell Dimension XPS 466V Ultimate certainly is not.

It ships with 16MB. It c stuffed with up to 64ME It is one fast machine.

Enhanced, space-saving 101-key keyboard.

60 MILLION WINMARKS

*The Viper Video Card. At 60 million WINMARKS,** it's the fastest PC graphics accelerator on planet Earth. Stock equipment on the Dell Dimension XPS 466V Ultimate.*

intel inside

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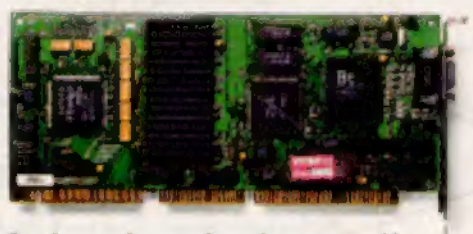
Featuring the Diamond Viper VL video board configured with 2MB video RAM, (the fastest PC graphics accelerator board on planet Earth) this speed demon is the perfect solution for color publishing, multimedia and high-end graphics applications.



Thanks to the Viper, the 466V Ultimate features a virtually flicker-free display at all resolutions. You can work with a palette of up to 16 million brilliant colors. For added speed and performance, the Viper comes with its own turbo drivers to drive all of your Windows™ 3.1 applications even faster. Oh and before we forget, the Viper has 2 megabytes of its own VRAM for the kind of face-warping acceleration that leaves others blinking in the dust.*

The 466V Ultimate comes fully decked out. With 16MB of RAM upgradeable to 64MB. A 450MB local bus IDE hard drive. High speed 256KB static RAM external cache. Five available 16-bit expansion slots — one of which can support an additional high-speed VL device. A 15-inch UltraScan™ 15FS non-interlaced monitor with 1024 x 768 pixel display. One internal diskette drive. Our double-spin CD ROM drive. Configured with MS-DOS® 6.0, Windows 3.1 and of course, a mouse.

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**Dell assumes no responsibility for face-warping acceleration injuries. **Performance measured by running WinBench version 3.11 at 1024 x 768, 256 colors.*